[Detailed Description of the Invention]
[0001]
[Field of the Invention]
Especially this invention relates to the drive method of the liquid crystal display which reduces power consumption about the drive method of a liquid crystal display.
[0002]
[Description of the Prior Art]
The liquid crystal display is widely used as a display device for man machine interfaces. For example, taking advantage of the feature that a lightweight thin display device is realizable, it is widely used as display devices, such as PDA (Personal Digital Assistants) and a portable telephone.
[0003]
There is the line sequential driving method for impressing predetermined voltage to the scanning electrode which chose and chose one scanning electrode at a time as a drive method of the liquid crystal display which pinches a liquid crystal between two or more scanning electrodes and two or more signal electrodes arranged so that it may intersect perpendicularly with a scanning electrode. There are APT (Alto Pleshko Technique) which makes regularity potential of the scanning electrode of a non selection line, IAPT (Improved APT) to which the potential of the scanning electrode of a non selection line is changed with a constant period, etc. in the line sequential driving method. There is also a plural lines simultaneous selection method (the multiline addressing method: MLA method) which chooses simultaneously two or more scanning electrodes other than the line sequential driving method.
[0004]
Drawing 17 shows the driving waveform in the case of driving a liquid crystal display by APT. Drawing 17 (a) - (c) shows change of the potential of the scanning electrode of the L-1st line, the Lth line, and the L+1st line, respectively. Drawing 17 (d) shows the example of change of the potential of one signal electrode. In APT, each scanning electrode is chosen one by one in connection with the passage of time. And an electric charge is supplied to the selected scanning electrode from the power supply circuit (it is hereafter described as V_{r1} power supply circuit.) which supplies predetermined voltage V_{r1}, and potential is set as V_{r1}. An electric charge is supplied to other scanning electrodes from the power supply circuit (it is hereafter described as V_M power supply circuit.) which supplies different predetermined voltage V_M from V_{r1}, and potential is set as V_M.
[0005]
The potential of each signal electrode is set up according to the indicative data of the pixel of a selection row. The potential of the signal electrode in which the pixel which should be made to turn on exists is set as V_{c1}, and the voltage of V_{r1}-V_{c1} is impressed to the pixel at the time of selection. The potential of the signal electrode in which the pixel which should be made to turn on does not exist is set as V_{c2}, and the voltage of V_{r1}-V_{c2} is impressed to the pixel at the time of selection. As a result, a desired picture is displayed on a selection row. However, potential V_{c1} and V_{c2} are set to satisfy $(V_{c1}+V_{c2}) / 2=V_M$ and $V_{c1}<V_M<V_{c2}<V_{r1}$.
[0006]
The height relation of the selected potential of a scanning electrode and potential of a signal electrode is reversed for every constant period in many cases. It is called straight polarity drive to drive so that the potential of the selected scanning electrode may become higher than the potential of a signal electrode. It is called negative polarity drive to drive so that the potential of

the selected scanning electrode may become lower than the potential of a signal electrode. When it changes from a straight polarity drive to a negative polarity drive, an electric charge is supplied to the selected scanning electrode from the power supply circuit (it is hereafter described as V_{r2} power supply circuit.) which supplies voltage V_{r2}, and potential is set as V_{r2}. However, it is determined that potential V_{r1} and V_{r2} serve as $(V_{r1}+V_{r2}) / 2=V_M$. For example, it is referred to as $V_{r2}=-V_{r1}$ and $V_M=0V$.

[0007]

In a negative polarity drive, the potential of the signal electrode in which the pixel which should be made to turn on exists is set as V_{c2}, and the voltage of $V_{r2}-V_{c2}$ is impressed to the pixel at the time of selection. The potential of the signal electrode in which the pixel which should be made to turn on does not exist is set as V_{c1}, and the voltage of $V_{r2}-V_{c1}$ is impressed to the pixel at the time of selection.

[0008]

Period T_r shown in drawing 17 shows the selection period of each scanning electrode. In the case of straight polarity, in the selection period of the L-1st line, the potential of the scanning electrode of the L-1st line is set as V_{r1}, and the potential of other scanning electrodes is set as V_M. Each scanning electrode forms a capacitor with each signal electrode which counters. If electric capacity of the capacitor which one scanning electrode and each signal electrode form is made into C_r, in the selection period of the L-1st line, the electric charge of V_{r1} and C_r will be stored in the liquid crystal layer between the scanning electrode of the L-1st line, and each signal electrode. This charge quantity may be changed by setting out of the potential of each signal electrode. Here, the number of signal electrodes of potential V_{c1} and the number of signal electrodes of potential V_{c2} are the same numbers, and it explains as that from which the average potential of each signal electrode becomes V_M (0V). If the selection period of the L-1st line expires and the selection period of the Lth line begins, the potential of the scanning electrode of the L-1st line will be set as V_M by V_M power supply circuit. At this time, the liquid crystal layer between the scanning electrode of the L-1st line and each signal electrode discharges the electric charge of $-(V_{r1}-V_M)\ C_r$ to V_M power supply circuit. On the other hand, the liquid crystal layer between the scanning electrode of the Lth line and each signal electrode is charged by V_{r1} power supply circuit, and only $-(V_{r1}-V_M)\ C_r$ increases the electric charge to accumulate. And the potential of the scanning electrode of the Lth line changes from V_M to V_{r1}. Change of the electric charge in the case of changing a selection row from the Lth line to the L+1st line is also the same. Thus, potential of the scanning electrode chosen while choosing each scanning electrode is made into V_{r1}, and potential of other scanning electrodes is made into V_M. Although the straight polarity drive was explained to the example here, it is the same even if it is a negative polarity drive.

[0009]

At IAPT, the potential of the scanning electrode of a non selection line is changed by a straight polarity drive and negative polarity drive. In MLA, two or more scanning electrodes are chosen simultaneously, and the potential of each selected scanning electrode is set as predetermined potential, respectively. For example, four scanning electrodes are chosen simultaneously and the potential of each scanning electrode is set up. Then, four another scanning electrodes are chosen simultaneously and each potential is set up.

[0010]

In conventional APT as shown in drawing 17, when changing a selection row, the liquid crystal layer between the scanning electrode selected till then and each scanning electrode discharges

the electric charge of $-(V_{r1}-V_M) C_r$ to V_M power supply circuit. The electric charge discharged from the scanning electrode is not used at all. Also in the case of IAPT and MLA, this is the same.

[0011]

Then, the drive method and LCD driver of the capacitive display device which reduce power consumption using effectively the electric charge discharged from a scanning electrode are proposed. For example, when driving in a JP,2001-312257,A gazette so that a scanning electrode may be charged on the voltage charged at the time of the last charge, and the voltage of reverse polarity, the drive method which carries out charge and discharge to middle potential is once indicated. It is an LCD driver which adopts MLA as a JP,2002-91387,A gazette, and when changing the block (subgroup) of the scanning electrode to choose, the LCD driver made to short-circuit the scanning electrodes to which the chosen block and the block to be chosen from now on correspond is indicated.

[0012]

[Problem to be solved by the invention]

However, in a drive method given in a JP,2001-312257,A gazette, only when charging a scanning electrode on the voltage charged at the time of the last charge, and the voltage of reverse polarity, the electric charge discharged from a scanning electrode can be reused. Therefore, when the frequency where a scanning electrode is charged on the voltage of the time of the last charge and reverse polarity is low, there is a problem that there are few reduction effects of power consumption. For example, when shown in drawing 17, in the period which is performing the straight polarity drive, potential of a selection row is made into V_M from V_{r1}, and when making potential of the following selection row into V_{r1} from V_M, an electric charge cannot be reused.

[0013]

In an LCD driver given in a JP,2002-91387,A gazette, when each signal electrode is set as the potential according to the selected block, the scanning electrodes of the selected block and the block chosen as the next are short-circuited. Therefore, the scanning electrode of the block chosen as the next serves as potential other than potential at the time of the non selection which should be set up essentially, and there is a problem that display quality falls.

[0014]

When the scanning electrodes to which a selected block and the following block correspond are short-circuited, power consumption may become large on the contrary. For example, it is assumed that the first line scanning electrode of a block under selection is set as potential V_r. Potential of the first line scanning electrode of a block which should be chosen as the next at this time is 0V. And if the first scanning electrode is short-circuited, potential of each scanning electrode will be set to $V_r/2$. When potential of the first line scanning electrode of the block should be set as $-V_r$ at the time of selection of the following block, $-V_r$ will have to be charged from $V_r/2$ and power consumption will become large on the contrary rather than a time of charging $-V_r$ from 0V.

[0015]

Then, this invention raises reuse efficiency of an electric charge, without reducing display quality, and an object of this invention is to enable it to reduce power consumption more.

[0016]

[Means for solving problem]

The mode 1 of this invention is a drive method of a liquid crystal display which pinches a liquid

crystal between two or more scanning electrodes and two or more signal electrodes, For each [which scans a scanning electrode, choosing a scanning electrode and chooses a scanning electrode] selection period of every. A selected scanning electrode is connected to a predetermined capacitor during fixed time of the beginning in a selection period, Potential of a scanning electrode is set as potential after the fixed time progress at the time of selection, the scanning electrode is connected to a capacitor during fixed time of the last in a selection period, and a drive method of a liquid crystal display setting potential of the scanning electrode as potential at the time of non selection at the time of a start of the next selection period is provided.
[0017]
The mode 2 of this invention chooses one scanning electrode at a time, and a selected scanning electrode is set as potential at the time of potential or the second selection at the time of the first selection, In setting a selected scanning electrode as potential at the time of the first selection, During fixed time of the last during fixed time of the beginning in a selection period, and in a selection period, In connecting a selected scanning electrode to a capacitor corresponding to potential at the time of the first selection and setting a selected scanning electrode as potential at the time of the second selection, A drive method of a liquid crystal display which connects a selected scanning electrode to a capacitor corresponding to potential at the time of the second selection during fixed time of the last during fixed time of the beginning in a selection period and in a selection period is provided.
[0018]
The mode 3 of this invention chooses one scanning electrode at a time, and a selected scanning electrode is set as potential at the time of potential or the second selection at the time of the first selection, In setting a selected scanning electrode as potential at the time of the first selection, In setting other scanning electrodes as potential at the time of the first non selection and setting a selected scanning electrode as potential at the time of the second selection, When setting other scanning electrodes as potential at the time of the second non selection and setting a selected scanning electrode as potential at the time of the first selection, During fixed time of the last during fixed time of the beginning in a selection period, and in a selection period, Also when connecting a selected scanning electrode to a predetermined capacitor and setting a selected scanning electrode as potential at the time of the second selection, a drive method of a liquid crystal display which connects a selected scanning electrode to the capacitor during fixed time of the last during fixed time of the beginning in a selection period and in a selection period is provided.
[0019]
The mode 4 of this invention chooses two or more scanning electrodes simultaneously, and each selected scanning electrode is set as one potential of the potential at the time of potential and the second selection at the time of the first selection, respectively, During the fixed time of the beginning in the selection period which chooses two or more scanning electrodes simultaneously, The scanning electrode which should be set as potential at the time of the first selection is connected to the capacitor corresponding to potential at the time of the first selection, The scanning electrode which should be set as potential at the time of the second selection is connected to the capacitor corresponding to potential at the time of the second selection, The drive method of the liquid crystal display which connects to the capacitor corresponding to potential the scanning electrode set as potential at the time of the first selection during the fixed time of the last in a selection period at the time of the first selection, and connects to the capacitor corresponding to potential the scanning electrode set as potential at the time of the

second selection at the time of the second selection is provided.
[0020]
The mode 5 of this invention makes 1 time the number of times which connects one selected scanning electrode or each scanning electrode at the time of choosing two or more simultaneously to a capacitor during the fixed time of the beginning of a selection period, The drive method of the liquid crystal display which makes 1 time the number of times which connects one selected scanning electrode or each scanning electrode at the time of choosing two or more simultaneously to a capacitor during the fixed time of the last of a selection period is provided.
[0021]
The mode 6 of this invention connects the scanning electrode selected during the fixed time of the beginning of a selection period to two or more capacitors in order, and provides the drive method of the liquid crystal display which connects the selected scanning electrode to two or more capacitors at turn contrary to previous turn during the fixed time of the last of a selection period.
[0022]
[Mode for carrying out the invention]
Hereafter, an embodiment of the invention is described with reference to Drawings.
[Embodiment 1] A first embodiment is described. According to a first embodiment, APT or MLA is adopted. First, the case where APT is adopted is explained. Drawing 1 is a block diagram showing the example of the drive of the liquid crystal display in the case of adopting APT. The liquid crystal cell 1 is provided with a liquid crystal between two or more scanning electrodes and two or more signal electrodes. Each scanning electrode and each signal electrode are arranged so that it may intersect perpendicularly mutually.
[0023]
The scanning electrode driver 2 and the signal electrode driver 3 have two or more voltage-output terminals, respectively. Each scanning electrode of the liquid crystal cell 1 is connected to each voltage-output terminal and couple 1 of the scanning electrode driver 2. Each signal electrode of the liquid crystal cell 1 is connected to each voltage-output terminal and couple 1 of the signal electrode driver 3.
[0024]
Choosing a scanning electrode, the scanning electrode driver 2 drives the liquid crystal cell 1 so that all the scanning electrodes may be scanned. When adopting APT, one selected scanning electrode is set as predetermined potential, and the potential of the scanning electrode of a non selection line is set as V_M (at the time of non selection potential). Here, it is $V_M=0V$, and the scanning electrode chosen at the time of a straight polarity drive is set as potential V_r (at the time of the first selection potential), and the case where the scanning electrode chosen at the time of a negative polarity drive is set as potential-V_r (at the time of the second selection potential) is explained to an example.
[0025]
The signal electrode driver 3 sets the potential of each signal electrode as the potential according to the indicative data of the pixel of a selection row during one selection period of a scanning electrode. At the time of a straight polarity drive, the signal electrode driver 3 sets the potential of the signal electrode in which the pixel which should be made to turn on among the pixels of a selection row exists as -V_c, and sets the potential of the signal electrode in which the pixel which should be made to turn on does not exist as V_c. At the time of a negative polarity drive, the signal

electrode driver 3 sets the potential of the signal electrode in which the pixel which should be made to turn on among the pixels of a selection row exists as V_c, and sets the potential of the signal electrode in which the pixel which should be made to turn on does not exist as $-V_c$. However, it is assumed that $-V_r<-V_c<V_M<V_c<V_r$ is satisfied.

[0026]

The power supply circuit 23 supplies voltage V_r, V_M (0V), and $-V_r$ to the scanning electrode driver 2. The V_r wiring 24, the V_M wiring 25, and the $-V_r$ wiring 26 are wiring for supplying voltage V_r, V_M, and $-V_r$ to the scanning electrode driver 2, respectively. The power supply circuit 23 supplies voltage V_c and $-V_c$ to the signal electrode driver 3. Drawing 1 simplified and showed the wiring for supplying voltage to the signal electrode driver 3 one. Drawing 2 is an explanatory view showing the example of the power supply circuit 23. The power supply circuit 23 is provided with the following.

The outgoing end 27 of voltage V_r.

The outgoing end 28 of voltage V_M.

The outgoing end 29 of voltage-V_r.

Although it also had the outgoing end of voltage V_c and $-V_c$, the graphic display was omitted in drawing 2.

[0027]

Capacitor 27 $_a$ for stabilizing output voltage, respectively, 28 $_a$, and 29 $_a$ are provided in the outgoing ends 27, 28, and 29 of each voltage. The power supply circuit 23 is provided with the capacitor 32 for V_r (capacitor corresponding to [time of the first selection] potential) and the switch 30 for V_r corresponding to the outgoing end 27 of voltage V_r. Similarly, it has the capacitor 33 for $-V_r$ (capacitor corresponding to [time of the second selection] potential) and the switch 31 for $-V_r$ corresponding to the outgoing end 29 of voltage-V_r.

[0028]

A signal (it is hereafter described as SHARE.) which controls a change of the switch 30 for V_r and the switch 31 for $-V_r$ is inputted into the power supply circuit 23 from the controller 22. The switch 30 for V_r changes a connection destination of the V_r wiring 24 to the outgoing end 27 of voltage V_r, or the capacitor 32 for V_r according to SHARE. Similarly, the switch 31 for $-V_r$ changes a connection destination of the $-V_r$ wiring 26 to the outgoing end 29 of voltage-V_r, or the capacitor 33 for $-V_r$ according to SHARE. Here, when SHARE is high-level, a case where a connection destination of the wiring 24 for V_r and the wiring 26 for $-V_r$ is changed to the capacitor 32 for V_r and the capacitor 33 for $-V_r$, respectively is explained to an example. In this case, if SHARE is set to a low level, a connection destination of the wiring 24 for V_r and the wiring 26 for $-V_r$ will be changed to the outgoing end 27 of V_r, and the outgoing end 29 of $-V_r$, respectively. The V_M wiring 25 is connected to the outgoing end 28 of voltage V_M.

[0029]

As for the electric capacity (it is considered as C_0.) of the capacitor 32 for V_r, and the capacitor 33 for $-V_r$, it is preferred that they are 10 or more times of electric capacity C_r of the capacitor which one scanning electrode and each signal electrode form. They may be 100 or more times still more preferably. C_0 is larger than C_r enough -- if it becomes and time will pass, the switch lateral electrode of the capacitor 32 for V_r will be converged on the potential ($V_r/2$) of about 1 law. Similarly, the switch lateral electrode of the capacitor 33 for $-V_r$ is also converged on almost fixed potential ($-V_r/2$). Why the converged value of potential becomes V_r / 2 grades is mentioned later. If C_0 is larger than C_r enough, even if the connection destination of the wiring 24 for V_r or the wiring 26 for $-V_r$ is changed by the switch 30 for V_r, or the switch 31 for $-V_r$, the convergent

potential will hardly change. By the following explanation, the switch lateral electrode of the capacitor 32 for V_r and the capacitor 33 for $-V_r$ explains as what is $V_r/2$, and $-V_r/2$, respectively.
[0030]
The memory 21 is provided with the following.
The storage area which memorizes the indicative data corresponding to each scanning electrode.
The outputting part which outputs indicative-data (Data) for a party to the signal electrode driver 3 according to control of the controller 22 (not shown).
The controller 22 outputs the memory control signal which specifies the address of the data for the party which the memory 21 should output to the memory 21. The outputting part with which the memory 21 is provided copies the indicative data memorized to the address specified by a memory control signal to the output data area to the signal electrode driver 3. The controller 22 outputs CL (clock signal) which is a latch pulse which shows the change of the scanning electrode to choose, and the signal (it is hereafter described as FR.) which directs whether it should make a straight polarity drive or it should make a negative polarity drive to the signal electrode driver 3. The signal electrode driver 3 reads the indicative data for the party copied to the output data area of the memory 21 according to the input timing of CL. And according to the indicative data and FR, the potential of each signal electrode is set up at the time of the input of the following CL.
[0031]
The controller 22 outputs FLM (first traffic line marker) which indicates the starts of one frame to be CL and FR to the scanning electrode driver 2. The controller 22 outputs SHARE to the power supply circuit 23. The controller 22 makes SHARE high-level during the first prescribed period in each selection period. During the prescribed period of the last [in / in the controller 22 / each selection period] makes SHARE high-level. Hereafter, the period which makes SHARE high-level is described in the beginning of each selection period, and the last as T_s.
[0032]
It is judged whether the scanning electrode driver 2 and the signal electrode driver 3 make it a negative polarity drive whether a straight polarity drive is used in the selection period based on FR at the time of a start of a certain selection period (when CL is inputted). Therefore, when outputting CL and starting a new selection period, the controller 22 outputs CL, after it starts an output of FR according to the selection period. A change cycle (change cycle of a straight polarity drive and a negative polarity drive) of FR is more than a selection period.
[0033]
Drawing 3 is an explanatory view showing an example of composition of the scanning electrode driver 2. The scanning electrode driver 2 has the following.
First wiring 14 in which it is connected to the V_r wiring 24, and voltage V_r is supplied.
Second wiring 15 in which it is connected to the V_M wiring 25, and voltage V_M is supplied.
-Third wiring 16 in which it is connected to the V_r wiring 26, and voltage-V_r is supplied.
Each scanning electrode is connected to either of the third wiring 16 from the first wiring 14. If wiring to which a scanning electrode is connected is changed, potential of the scanning electrode will also be changed. Each scanning electrode, the switch 11 corresponding to the couple 1 - 13 grades perform a change of connection. The switches 11-13 are connected to a scanning electrode of the first to third line, respectively. In drawing 3, although a switch corresponding to the third line is shown from the first line, the scanning electrode driver 2 has a switch corresponding to each line.
[0034]

Even if the scanning electrode driver 2 is which [of a straight polarity drive and a negative polarity drive] case, with the switch corresponding to a non selection line, it connects a scanning electrode of a non selection line to the second wiring 15, and sets potential of the scanning electrode as V_M. In a straight polarity drive, the scanning electrode driver 2 connects a scanning electrode of a selection row to the first wiring 14 with the switch corresponding to a selection row. In a negative polarity drive, a scanning electrode of a selection row is connected to the third wiring 16 with the switch corresponding to a selection row.
[0035]
The scanning electrode driver 2 has a counter (not shown) which counts input frequency of CL, and whenever CL is inputted, he makes a counter value increase one time. The scanning electrode driver 2 judges a scanning electrode which should be chosen based on a counter value. A counter initializes a counter value, when FLM is inputted. The scanning electrode driver 2 is chosen from the first line based on a counter value after initialization, if FLM is inputted. Timing to which the controller 22 outputs FLM and CL is set that each scanning electrode is chosen 1 time respectively for every frame. As already stated, the scanning electrode driver 2 judges a straight polarity drive or a negative polarity drive based on FR at the time of a selection period start. The scanning electrode driver 2 judges a scanning electrode and a straight polarity drive which should be chosen, or a negative polarity drive, and connects each scanning electrode to one of wiring with a switch.
[0036]
Drawing 4 is an explanatory view showing the example of the driving waveform according to the signal with the timing to which the controller 22 outputs a signal at the time of a drive. Here, when the controller 22 directs a straight polarity drive, FR is made high-level, and when directing a negative polarity drive, the case where FR is made into a low level is explained to an example. The case where the controller 22 changes the level of FR for every frame is explained to an example. The scanning electrode driver 2 will change the scanning electrode chosen according to CL inputted following FLM one by one, if FLM is inputted. Period T_r after CL is inputted until the following CL is inputted is a selection period of one scanning electrode.
[0037]
The scanning electrode driver 2 will choose the scanning electrode of the first line, if CL is first inputted following FLM. If FR at the time of CL input is high-level, it will be judged that a straight polarity drive is performed. Therefore, the scanning electrode driver 2 connects the scanning electrode of the first line to the first wiring 14 with the switch 11, and connects the scanning electrode of a non selection line to the second wiring 15 with each of other switch until CL is inputted next. At this time, the scanning electrode of a non selection line is connected to the outgoing end 28 of voltage V_M via the second wiring 15 and the V_M wiring 25, and the potential of that scanning electrode is set as V_M.
[0038]
The signal electrode driver 3 sets the potential of each signal electrode as V_c or $-V_c$ during a selection period according to the indicative data of the first line. Here, the number of the signal electrode of potential V_c and the number of the signal electrode of potential-V_c shall be equal, and the average potential of each signal electrode shall become fixed.
[0039]
The controller 22 makes SHARE high-level between prescribed period T_s, after outputting CL. Then, the switch 30 for V_r of the power supply circuit 23 connects the V_r wiring 24 and the capacitor 32 for V_r. Therefore, the scanning electrode of the first line is connected to the

capacitor 32 for V_r via the first wiring 14 and the V_r wiring 24. as a result, the scanning electrode of the first line -- the switch lateral electrode of the capacitor 32 for V_r -- being equipotential ($V_r/2$) -- it becomes. Since electric capacity C_0 of the capacitor 32 for V_r is large enough compared with C_r, even if it supplies an electric charge to a scanning electrode, the potential of the switch lateral electrode of the capacitor 32 for V_r hardly changes.
[0040]
The length of prescribed period T_s is set or more [of the damping time constant (product of the resistance R and C_r of each scanning electrode) of at least one scanning electrode] to 1/2. Thus, by defining T_s, time for an electric charge to move between the capacitor 32 for V_r and scanning electrodes is securable.
[0041]
In the switch 31 for $-V_r$, SHARE connects the $-V_r$ wiring 26 and the capacitor 33 for $-V_r$ between high level. However, the scanning electrode driver 2 does not connect a scanning electrode to the third wiring 16 at the time of a straight polarity drive. Therefore, at the time of a straight polarity drive, the capacitor 33 for $-V_r$ does not affect the potential of each scanning electrode.
[0042]
The controller 22 will make SHARE a low level, if prescribed period T_s passes since the start of a selection period. Then, the switch 30 for V_r of the power supply circuit 23 connects the V_r wiring 24 and the outgoing end 27 of voltage V_r. Therefore, the scanning electrode of the first line is connected to the outgoing end 27 of voltage V_r via the first wiring 14 and the V_r wiring 24, and the potential of the scanning electrode of the first line becomes V_r.
[0043]
The controller 22 makes SHARE high-level again between prescribed period T_s of the last in a selection period. Then, the switch 30 for V_r of the power supply circuit 23 connects the V_r wiring 24 and the capacitor 32 for V_r. at this time, an electric charge moves to the capacitor 32 for V_r from the scanning electrode of the first line -- the scanning electrode of the first line -- the switch lateral electrode of the capacitor 32 for V_r -- being equipotential ($V_r/2$) -- it becomes. Since electric capacity C_0 of the capacitor 32 for V_r is large enough compared with C_r, even if an electric charge moves from a scanning electrode, the potential of the switch lateral electrode of the capacitor 32 for V_r hardly changes.
[0044]
The controller 22 outputs CL at the time of a start of the next selection period. If this CL is inputted, the scanning electrode driver 2 will connect a scanning electrode of the second line to the first wiring 14 with the second-line switch, and will connect other scanning electrodes to the second wiring 15 with each of other switch. As a result, a scanning electrode of the first line is connected to the outgoing end 28 of voltage V_M via the second wiring 15 and the V_M wiring 25. And potential of a scanning electrode of the first line changes from $V_r/2$ to V_M.
[0045]
As well as the time of the first-line selection when choosing the second line or subsequent ones, the controller 22 and the power supply circuit 23 operate. As a result, a process in which move an electric charge to a scanning electrode of a selection row from the capacitor 32 for V_r by prescribed period T_s of the beginning of each selection period, and an electric charge is moved to a capacitor for V_r from a scanning electrode of a selection row by prescribed period T_s of the last of each selection period is repeated. The number of times which connects a scanning electrode selected between prescribed period T_s of the beginning of each selection period to a capacitor (here capacitor 32 for V_r) is 1 time. The number of times which connects a scanning electrode

selected between prescribed period T_s of the last of each selection period to a capacitor is also 1 time.
[0046]
According to such a drive method, the newly selected scanning electrode is first connected to the capacitor 32 for V_r, and the potential of the scanning electrode changes from V_M to $V_r/2$. At this time, an electric charge is not supplied from the outgoing end 27 of voltage V_r. Then, if the scanning electrode of a selection row is connected to the outgoing end 27 of voltage V_r, the power supply circuit 23 will supply the electric charge of C_r and $V_r/2$ from the outgoing end 27 of voltage V_r, and the potential of the scanning electrode of a selection row will become V_r. Thus, what is necessary is to supply the electric charge of C_r and $V_r/2$ to the selection row of potential $V_r/2$, and just to make potential into V_r, and when the potential of a selection row is V_M, it is not necessary to supply the electric charge of C_r and V_r and to make potential of a selection row into V_r. Therefore, the electric charge which should be supplied from the outgoing end 27 of voltage V_r is reduced by half.
[0047]
The scanning electrode of a selection row is connected to the capacitor 32 for V_r at the last of a selection period, and the potential of the scanning electrode changes from V_r to $V_r/2$. At this time, an electric charge is not emitted to the outgoing end 28 of voltage V_M. It is connected to the outgoing end 28 of voltage V_M at the time of the start of the next selection period, and this scanning electrode emits the electric charge of C_r and $V_r/2$. And potential changes to V_M. Thus, what is necessary is to emit the electric charge of C_r and $V_r/2$ from the selection row of potential $V_r/2$, and just to make potential into V_M, and when the potential of a selection row is V_r, it is not necessary to emit the electric charge of C_r and V_r and to make potential of a selection row into V_M. Therefore, the electric charge emitted to the outgoing end 28 of voltage V_M decreases.
[0048]
Here, the time of a straight polarity drive was explained to the example. The operation at the time of a negative polarity drive is the same as that of the time of a straight polarity drive except the point which an electric charge moves between the capacitor 33 for $-V_r$, and a scanning electrode. That is, by prescribed period T_s of the beginning of a selection period, the capacitor 33 for $-V_r$ supplies an electric charge to the scanning electrode of a selection row, and sets potential of a selection row to $-V_r/2$. Then, an electric charge is supplied to the scanning electrode of a selection row from the outgoing end 29 of $-V_r$ voltage, and potential of a selection row is made into $-V_r$. In prescribed period T_s of the last of a selection period, an electric charge is moved to the capacitor 33 for $-V_r$ from the scanning electrode of a selection row, and potential of a selection row is set to $-V_r/2$. If a selection period changes, an electric charge is moved to the outgoing end 28 of voltage V_M from the scanning electrode selected till then, and it is potential. - It is made to change from $V_r/2$ to V_M.
[0049]
According to the drive method of a first embodiment, an electric charge is moved to the capacitor 32 for V_r, or the capacitor 33 for $-V_r$ from the scanning electrode chosen as the last of selection period T_r. And an electric charge is supplied to the scanning electrode chosen as the next from the capacitor 32 for V_r, or the capacitor 33 for $-V_r$. Therefore, the charge quantity emitted to the outgoing end 28 of voltage V_M from the scanning electrode selected till then and the charge quantity supplied to the scanning electrode chosen from the outgoing end 27 of voltage V_r as the next can be decreased at the time of a selection row change. Not only in when changing from a straight polarity drive to a negative polarity drive, but each selection period,

there are little charge quantity which should be supplied, and charge quantity emitted, and it ends. Therefore, the power consumption at the time of driving a liquid crystal display can be reduced. Since the potential of a non selection line is maintained at V_M, the potential of a non selection line changes and display quality does not fall.

[0050]

Next, the converged value of the potential of the switch lateral electrode of the capacitor 32 for V_r and the capacitor 33 for $-V_r$ is explained. Here, the capacitor 32 for V_r used at the time of a straight polarity drive is explained to an example. Suppose that the potential of the switch lateral electrode of the capacitor 32 for V_r is V_g at a certain time during the period when SHARE serves as a low level. Then, potential of the switch lateral electrode of the capacitor 32 for V_r when SHARE becomes high-level is made into V_h. Since the scanning electrode of a selection row is connected to the capacitor 32 for V_r when SHARE is high-level, the potential of this scanning electrode also serves as V_h. The relation of the following formulas 1 is materialized at this time.

[0051]

C_r, V_h+C_0, and V_h=C_r, V_r+C_0, and V_g (formula 1)

[0052]

Then, the controller's 22 output of CL will connect to the capacitor 32 for V_r the scanning electrode whose potential was V_M (=0V) till then. And suppose that the scanning electrode and the switch lateral electrode of the capacitor 32 for V_r which were connected became V_i. The relation of the following formulas 2 is materialized at this time.

[0053]

C_r, V_i+C_0, and V_i=C_0 and V_h (formula 2)

[0054]

When V_h is eliminated from the formula 1 and the formula 2 and V_i is calculated, it comes to be shown in the formula 3.

[0055]

V_i=(C_0- (C_r, V_r+C_0, and V_g))/(C_r+C_0) ^{2} (formula 3)

[0056]

The formula 3 can be transformed and it can express as the following formulas 4.

[0057]

V_i - alpha=k- (V_g-alpha) (formula 4)

[0058]

However, alpha and k are expressed, respectively, as shown in the formula 5 and the formula 6.

[0059]

alpha=(C_0/(C_r+2 and C_0)) -V_r (formula 5)

[0060]

k=(C_0/(C_r+C_0)) ^{2} (formula 6)

[0061]

Then, also when SHARE is set to a low level, the potential of the switch lateral electrode of the capacitor 32 for V_r is still V_i. Therefore, change of the potential of the switch lateral electrode of the capacitor 32 for V_r when one selection period has passed since a certain time during the period when SHARE serves as a low level is expressed with the formula 4. Therefore, when n selection periods pass, potential V_p comes to be shown in the following formulas 7.

[0062]

V_p=k^{n-1}-(V_g-alpha)+alpha (formula 7)

[0063]

n is a natural number here. When time fully passes, the potential can ask for n by infinity and Lycium chinense in the formula 7. It is k< 1 from the formula 6. Therefore, V_p is converged on alpha. And since it is $C_r << C_0$, it can be regarded as alpha=$V_r/2$ from the formula 5. Therefore, potential of a switch lateral electrode of the capacitor 32 for V_r is converged on $V_r/2$. Similarly, potential of a switch lateral electrode of the capacitor 33 for $-V_r$ is also converged on $-V_r/2$.
[0064]
Next, a case where MLA is adopted is explained. Drawing 5 is a block diagram showing an example of a drive of a liquid crystal display in a case of adopting MLA. The liquid crystal cell 1 is the same as a liquid crystal cell shown in drawing 1. The scanning electrode driver 42 and the signal electrode driver 43 have two or more voltage-output terminals, respectively. Each scanning electrode of the liquid crystal cell 1 is connected to each voltage-output terminal and couple 1 of the scanning electrode driver 42. Each signal electrode of the liquid crystal cell 1 is connected to each voltage-output terminal and couple 1 of the signal electrode driver 43.
[0065]
The scanning electrode driver 42 chooses two or more scanning electrodes simultaneously. The group of the scanning electrode chosen simultaneously is called subgroup (or block). Changing a subgroup, the scanning electrode driver 42 chooses each scanning electrode, and drives the liquid crystal cell 1. The scanning electrode driver 42 holds the information on the selection row sequence of an L line K sequence that the potential of each scanning electrode in a subgroup is defined. L is a number of the scanning electrode chosen simultaneously. Hereafter, the case of L= 4 is explained to an example. Drawing 6 shows the example of a selection row sequence. Each line of a selection row sequence corresponds to each line of a subgroup. For example, the element of the first line of a selection row sequence is applied to the first line of a subgroup. The controller 41 outputs the signal which shows the element of what row of a selection row sequence should be applied to the scanning electrode driver 42. Hereafter, this signal is expressed as "ROW (1:0)." For example, when ROW (1:0) specifies the second row, the element "1" of the second row, "-1", "1", and "-1" are applied to the first to the fourth scanning electrode of a subgroup, respectively. In the following explanation, the scanning electrode driver 42 assumes that the information on the selection row sequence shown in drawing 6 is held.
[0066]
"1" as used in the selection row sequence shown in drawing 6 means setting potential as predetermined potential V_r (at the time of the first selection potential) at the time of a straight polarity drive, and setting potential as $-V_r$ (at the time of the second selection potential) at the time of a negative polarity drive. "-1" means setting potential as $-V_r$ at the time of a straight polarity drive, and setting potential as V_r at the time of a negative polarity drive. The controller 41 outputs ROW (1:0) so that each sequence of a selection row sequence may be uniformly specified to each subgroup. For example, the sequence to specify is changed, when choosing each subgroup 1 time respectively and redoing selection from the first subframe again.
[0067]
Signal FR which shows whether the controller 41 should be made to a straight polarity drive or it should make a negative polarity drive, Clock signal CL which instructs the change of a subgroup to be a signal (it is hereafter described as PM.) which directs to redo selection from the first subgroup is outputted to the scanning electrode driver 42. The scanning electrode driver 42 changes the subgroup which will be chosen if CL is inputted. That is, a period after CL is inputted until the following CL is inputted becomes selection period T_r of one subgroup. The scanning electrode driver 42 has a counter which counts the input frequency of CL, and

whenever CL is inputted, he makes a counter value increase one time. However, a counter value is initialized when PM is inputted. Each scanning electrode (subgroup) which should be chosen is specified from a counter value.

[0068]

The scanning electrode driver 42 determines potential which should be set as a scanning electrode in a subgroup to choose based on FR and ROW (1:0) at the time of a start of a certain selection period (when CL is inputted). Therefore, when outputting CL and starting a new selection period, the controller 41 outputs CL, after it starts an output of FR and ROW (1:0) according to the selection period. A change cycle of FR is more than a selection period.

[0069]

a scanning electrode of a subgroup which has not chosen the scanning electrode driver 42 -- predetermined voltage V_M (at time of non selection potential) setting out -- it carries out. Here, it is referred to as V_M=0V.

[0070]

The memory 46 is provided with the following.

A storage area which memorizes an indicative data corresponding to each scanning electrode.

An outputting part which outputs indicative-data (Data) for a multi-line chosen to the MLA arithmetic circuit 44 (not shown).

The controller 41 outputs a memory control signal which specifies an address of data for a multi-line which the memory 46 should output to the memory 46. An outputting part with which the memory 46 is provided copies an indicative data memorized to an address specified by a memory control signal to an output data area to the MLA arithmetic circuit 44.

[0071]

The MLA arithmetic circuit 44 holds a selection row sequence beforehand, and calculates the pattern of the voltage which the signal electrode driver 43 should set as each signal electrode by a selection row sequence. The controller 41 outputs ROW (1:0), FR, and CL to the MLA arithmetic circuit 44. The MLA arithmetic circuit 44 is the timing into which CL is inputted, reads the indicative data for a multi-line from the output data area of the memory 46, and calculates the pattern of the voltage which should be set as each signal electrode based on the indicative data, and ROW (1:0) and FR. The MLA arithmetic circuit 44 outputs the result of an operation to the signal electrode driver 43. The signal electrode driver 43 sets up the potential of each signal electrode in each selection period according to this result of an operation.

[0072]

Generally, by MLA, if the line number by which simultaneous selection is made is set to L, the number of the potential levels of a signal electrode will be set to L+1. In the case of four-line simultaneous selection, the power supply circuit 45 supplies five kinds of voltage of V_{10} - V_{14} to the signal electrode driver 43. The power supply circuit 45 outputs voltage V_r, V_M, and -V_r to the scanning electrode driver 42 via the V_r wiring 24, the V_M wiring 25, and the -V_r wiring 26. The composition of the outgoing end of voltage V_r, V_M, and -V_r is the same as that of the case where it is shown in drawing 2. That is, the power supply circuit 45 equips the outgoing end of voltage V_r with the switch for V_r, and the capacitor for V_r. It has a switch and a capacitor also like the outgoing end of voltage-V_r. Hereafter, operation of the power supply circuit 45 is explained using drawing 2.

[0073]

As already explained, electric capacity C_0 of the capacitor 32 for V_r and the capacitor 33 for -V_r is larger than C_r enough. And it converges on V_r/2, and -V_r/2, and the potential of the switch

lateral electrode of the capacitor 32 for V_r and the capacitor 33 for $-V_r$ hardly changes, respectively.
[0074]
The controller 41 outputs signal SHARE which controls the change of the switch 30 for V_r, and the switch 31 for $-V_r$ to the power supply circuit 45. The power supply circuit 45 changes the switch 30 for V_r, and the switch 31 for $-V_r$ according to SHARE. The controller 41 makes SHARE high-level between prescribed period T_s of the beginning of each selection period T_r, and the last prescribed period T_s. In each selection period, the power supply circuit 45 As a result, between the first prescribed period T_s and the last prescribed period T_s, The switch 30 for V_r and the switch 31 for $-V_r$ are changed to the capacitor 32 for V_r, and capacitor 33 side for $-V_r$, respectively.
[0075]
Composition of the scanning electrode driver 42 is the same as composition shown in drawing 3. However, FR, PM, CL, and ROW (1:0) are inputted into the scanning electrode driver 42. Hereafter, operation of the scanning electrode driver 42 is explained using drawing 3. The scanning electrode driver 42 will change a subgroup one by one according to CL inputted following PM, if PM is inputted. After PM is inputted, input frequency of CL is counted.
[0076]
The scanning electrode driver 42 will connect a scanning electrode of a non selection line to the second wiring 15 with each switch of a non selection line, if CL is inputted. Then, an electric charge of a liquid crystal layer of a non selection line is discharged, and scanning electrode potential of a non selection line becomes V_M (=0V).
[0077]
The scanning electrode driver 42 changes the switch of each scanning electrode chosen simultaneously to the first the wiring 14 or the wiring 16 of the third based on FR and ROW (1:0) at the time of CL input. For example, FR is high level (straight polarity) and it is assumed that ROW (1:0) specifies the second row. in this case, the scanning electrode driver 42 should set the potential of each scanning electrode from the first line of a subgroup to the fourth line as V_r, $-V_r$, V_r, and $-V_r$ based on the element of the second row of the selection row sequence shown in drawing 6 "1", "-1", "1", and "-1" -- it judges. And the scanning electrode of the first line and the third line is connected to the first wiring 14 with the switch corresponding to the first line of a subgroup, and the third line. The scanning electrode of the second line and the fourth line is similarly connected to the third wiring 16.
[0078]
The controller 41 makes SHARE high-level after outputting CL until prescribed period T_s passes. At this time, the power supply circuit 45 changes the switch 30 for V_r, and the switch 31 for $-V_r$ to the capacitor 32 for V_r, and capacitor 33 side for $-V_r$, respectively. Then, the capacitor 32 for V_r supplies an electric charge to the scanning electrode of the first line and the third line of a subgroup, and changes the potential of the scanning electrode from V_M to $V_r/2$. The capacitor 33 for $-V_r$ supplies an electric charge to the scanning electrode of the second line and the fourth line, and changes the potential of the scanning electrode from V_M to $-V_r/2$.
[0079]
Then, the controller 41 makes SHARE a low level. At this time, the power supply circuit 45 changes the switch 30 for V_r, and the switch 31 for $-V_r$ to the outgoing end [of voltage V_r] 27, and outgoing end 29 side of voltage-V_r, respectively. Then, the outgoing end 27 of voltage V_r supplies an electric charge to the scanning electrode of the first line and the third line, and

changes the potential of the scanning electrode from $V_r/2$ to V_r. The outgoing end 29 of voltage-V_r supplies an electric charge to the scanning electrode of the second line and the fourth line, and is the potential of the scanning electrode. - It is made to change from $V_r/2$ to $-V_r$.
[0080]
Next, the controller 41 makes SHARE high-level again between prescribed period T_s of the last of a selection period. Then, the scanning electrode of the first line and the third line of a subgroup is again connected to the capacitor 32 for V_r. And the electric charge of this scanning electrode moves to the capacitor 32 for V_r, and the potential of a scanning electrode is set to $V_r/2$ from V_r. The scanning electrode of the second line and the fourth line is again connected to the capacitor 33 for $-V_r$. The electric charge of this scanning electrode moves to the capacitor 33 for $-V_r$, and the potential of a scanning electrode is set to $-V_r/2$ from $-V_r$.
[0081]
If the controller 41 outputs CL, the scanning electrode driver 42 will change the switch corresponding to four scanning electrodes selected till then to the second wiring 15. Then, the four scanning electrodes are connected to the outgoing end 28 of voltage V_M, and the potential of each scanning electrode changes from $V_r/2$ (or $-V_r/2$) to V_M.
[0082]
The number of times which connects each scanning electrode selected between prescribed period T_s of the beginning of each selection period to a capacitor (the capacitor 32 for V_r or the capacitor 33 for $-V_r$) is 1 time. The number of times which connects each scanning electrode selected between prescribed period T_s of the last of each selection period to a capacitor is also 1 time. The situation which receives or emits an electric charge does not change each scanning electrode of the selected subgroup to the case of APT. Therefore, even when MLA is adopted, the electric charge which should be supplied to a scanning electrode from the outgoing end 27 of voltage V_r or the outgoing end 29 of voltage-V_r can be decreased. The electric charge emitted to the outgoing end 28 of voltage V_M from a scanning electrode can also decrease. As a result, power consumption decreases. Since the potential of the subgroup which is not chosen does not turn into any potential other than V_M, display quality is also maintainable.
[0083]
In the above-mentioned explanation, it asks for the charge quantity which the outgoing end 27 of voltage V_r supplies, the potential of a scanning electrode, etc. by calculation. It checked that the electric charge was reused effectively not only the check by calculation but by actually driving a liquid crystal display. Hereafter, an embodiment is shown.
[0084]
[Embodiment 1] The liquid crystal display was driven with the drive method by a first embodiment. The liquid crystal cell which is provided with 3 sets of signal electrodes which serve as a lot by 320 as a liquid crystal display for a drive, and is provided with 240 scanning electrodes was created. The group of each signal electrode corresponds to R (red), G (green), and B (blue), respectively. The size of each pixel of a liquid crystal cell was 0.10 mm x 0.30 mm. Using the liquid crystal of 8.0, specific inductive capacity created the liquid crystal cell so that a cell gap might be set to 6.0 micrometers. In this liquid crystal cell, electric capacity C_r of the capacitor which one scanning electrode and each signal electrode form was 0.34nF.
[0085]
As a scanning electrode, the resistance from one end to the other end used the ITO electrode which is 4komega. When this scanning electrode is used, the damping time constant of one scanning electrode is estimated at 1.4 microseconds (microsecond).

[0086]
Electric capacity C_0 formed a capacitor which is 1 micro F (about 3000 times of C_r) in a power supply circuit as a capacitor for V_r, and a capacitor for $-V_r$. Voltage was supplied to a scanning electrode driver and a signal electrode driver from this power supply circuit, and a liquid crystal cell was driven. However, APT was adopted, a duty ratio was made into 1/176, and frame frequency was 60 Hz. Prescribed period T_s (period which makes SHARE high-level) provided in the beginning and the last in each selection period was set to 2.4 microseconds. The length of this prescribed period T_s is about 1.7 times the damping time constant. At this time, current from an outgoing end of voltage V_r was 198microA.
[0087]
The [comparative example 1] A liquid crystal cell was driven like Embodiment 1 except a point which always made SHARE a low level. At this time, current from an outgoing end of voltage V_r is 323microA, and increased from a case of Embodiment 1.
[0088]
[Embodiment 2] Electric capacity C_0 of a capacitor for V_r and a capacitor for $-V_r$ provided in a power supply circuit was changed. And change of current (current which flows from an outgoing end of voltage V_r) accompanying change of electric capacity C_0 was checked. As a liquid crystal display, the same liquid crystal cell as a liquid crystal cell used in Embodiment 1 was used. APT was adopted like Embodiment 1, a duty ratio was made into 1/176, and frame frequency was 60 Hz.
[0089]
When referred to as C_0=0.001micro F (about 3 times of C_r), current which flows from an outgoing end of voltage V_r was 300microA, and was comparable as 323microA shown in a comparative example. When referred to as C_0=0.01micro F (about 30 times of C_r), current which flows from an outgoing end of voltage V_r is 230microA, and decreased from 323microA shown in a comparative example. That is, charge quantity which should be supplied was able to be decreased. When referred to as C_0=0.1micro F (about 300 times of C_r), current which flows from an outgoing end of voltage V_r is 205microA, and charge quantity which should be supplied was able to be decreased further. When referred to as C_0=1micro F (about 3000 times of C_r) like Embodiment 1, current which flows from an outgoing end of voltage V_r is 198microA, and charge quantity which should be supplied was able to be decreased further.
[0090]
[Embodiment 3] Prescribed period T_s (period which makes SHARE high-level) provided in the beginning and the last in each selection period was changed. And change of current (current which flows from an outgoing end of voltage V_r) accompanying change of prescribed period T_s was checked. As a liquid crystal display, the same liquid crystal cell as a liquid crystal cell used in Embodiment 1 was used. Electric capacity C_0 of a capacitor for V_r and a capacitor for $-V_r$ could be 1 micro F like Embodiment 1. APT was adopted like Embodiment 1, a duty ratio was made into 1/176, and frame frequency was 60 Hz.
[0091]
When referred to as T_s=0.1microsecond (about 0.07 time of a damping time constant), current which flows from an outgoing end of voltage V_r was 323microA, and was comparable as 323microA shown in a comparative example. When referred to as T_s=0.6microsecond (about 0.4 time of a damping time constant), current which flows from an outgoing end of voltage V_r is 260microA, and decreased rather than 323microA shown in a comparative example. When referred to as T_s=2.4microsecond (about 1.7 times of a damping time constant) like Embodiment

1, current which flows from an outgoing end of voltage V_r is 198microA, and charge quantity which should be supplied was able to be decreased. When referred to as T_s=9.5microsecond (about 6.8 times of a damping time constant), current which flows from an outgoing end of voltage V_r was 194microA, and was comparable as a case of T_s=2.4microsecond.
[0092]
Although a liquid crystal cell used in Embodiments 1-3 is a 320x240-pixel liquid crystal cell, it cannot be overemphasized that this invention is applicable to other liquid crystal cells. For example, both a pixel number of a liquid crystal display generally used for a portable telephone and size of a pixel are smaller than a liquid crystal cell used in Embodiments 1-3. This invention is applicable also to a liquid crystal display of such a portable telephone.
[0093]
[Embodiment 2] Next, a second embodiment is described. IAPT is used for a second embodiment. Drawing 7 is a block diagram showing an example of a drive of a liquid crystal display in which a drive method of a second embodiment is applied. The same mark as drawing 1 shows equipment in a first embodiment, and same equipment, and they omit explanation.
[0094]
The scanning electrode driver 52 and the signal electrode driver 53 have two or more voltage-output terminals, respectively. Each scanning electrode of the liquid crystal cell 1 is connected to each voltage-output terminal and couple 1 of the scanning electrode driver 52. Each signal electrode of the liquid crystal cell 1 is connected to each voltage-output terminal and couple 1 of the signal electrode driver 53.
[0095]
Like a first embodiment, the controller 22 outputs FLM, and FR and CL to the scanning electrode driver 52, and outputs FR and CL to the signal electrode driver 53. SHARE is outputted to the power supply circuit 51. A change cycle (change cycle of a straight polarity drive and a negative polarity drive) of FR is more than a selection period.
[0096]
The power supply circuit 51 supplies voltage V_5, V_4, V_1, and V_0 to the scanning electrode driver 52. The V_5 wiring 65, the V_4 wiring 64, the V_1 wiring 61, and the V_0 wiring 60 are wiring for supplying voltage V_5, V_4, V_1, and V_0 to the scanning electrode driver 52 from the power supply circuit 51, respectively. The power supply circuit 51 supplies voltage V_5, V_3, V_2, and V_0 to the signal electrode driver 53. Drawing 7 simplified and showed wiring for supplying voltage to the signal electrode driver 53 one. Voltage V_0 which the power supply circuit 51 outputs - V_5, It is determined that $V_0<V_1<V_2<V_3<V_4<V_5$ and $V_5-V_4=V_1-V_0=V_4-V_3=V_2-V_1$ are materialized.
[0097]
Voltage V_5 is voltage impressed to the signal electrode in which the pixel which is impressed by the scanning electrode selected at the time of a straight polarity drive, and is made to turn on at the time of a negative polarity drive exists. Voltage V_4 is voltage impressed to the scanning electrode which is not chosen at the time of a negative polarity drive. Voltage V_3 is voltage impressed to the signal electrode in which the pixel made to turn on at the time of a negative polarity drive does not exist. Voltage V_2 is voltage impressed to the signal electrode in which the pixel made to turn on at the time of a straight polarity drive does not exist. Voltage V_1 is voltage impressed to the scanning electrode which is not chosen at the time of a straight polarity drive. Voltage V_0 is voltage impressed to the signal electrode in which the pixel which is impressed by the scanning electrode selected at the time of a negative polarity drive, and is made to turn on at the time of a straight polarity drive exists. Potential V_5 and V_0 are potential at the time of

potential and the second selection at the time of the first selection, respectively. Potential V_1 and V_4 are potential at the time of potential and the second non selection at the time of the first non selection, respectively.
[0098]
Drawing 8 is an explanatory view showing the example of the power supply circuit 51. The power supply circuit 51 is provided with the outgoing ends 70-75 for every voltage. Capacitor 70 $_a$ for stabilizing output voltage, respectively - 75 $_a$ are provided in the outgoing ends 70-75 of each voltage. The power supply circuit 51 is provided with the capacitor 77 for SHARE. The capacitor 77 for SHARE is the capacitor 77 for supplying an electric charge to the scanning electrode which receives and accumulates an electric charge and is newly chosen from the selected scanning electrode. That is, the same function as the capacitor 32 for V_r and the capacitor 33 for $-V_r$ in a first embodiment is achieved.
[0099]
As for electric capacity C_0 of the capacitor for SHARE, it is preferred that they are 10 or more times of electric capacity C_r of the capacitor which one scanning electrode and each signal electrode form. They may be 100 or more times still more preferably. C_0 is larger than C_r enough -- if it becomes and time will pass, the switch lateral electrode of the capacitor 77 for SHARE will be converged on the potential of about 1 law. This converged value is /4 as mentioned later $(V_5+V_1+V_4+V_0)$. If C_0 is larger than C_r enough, even if the connection destination of the V_5 wiring 65 or the V_0 wiring 60 is changed by the switch 78 for V_5, or the switch 79 for V_0, the convergent potential will hardly change. By the following explanation, the potential of the switch lateral electrode of the capacitor 77 for SHARE explains as what is $(V_5+V_1+V_4+V_0) / 4$.
[0100]
The power supply circuit 51 is provided with the following.
The switch 78 for V_5 corresponding to the V_5 wiring 65.
The switch 79 for V_0 corresponding to the V_0 wiring 60.
The signal (SHARE) which controls the change of the switch 78 for V_5 and the switch 79 for V_0 is inputted into the power supply circuit 51 like a first embodiment. And according to SHARE, the connection destination of the V_5 wiring 65 and the V_0 wiring 60 is changed. Here, when SHARE is high-level, the case where the output destination change of the wiring 65 for V_5 and the wiring 60 for V_0 is changed to the capacitor 77 for SHARE, respectively is explained to an example. In this case, if SHARE is set to a low level, the output destination change of the wiring 65 for V_5 and the wiring 60 for V_0 will be changed to the outgoing end 75 of voltage V_5, and the outgoing end 70 of voltage V_0, respectively. The V_4 wiring 64 and the V_1 wiring 61 are connected to the outgoing end 74 of voltage V_4, and the outgoing end 71 of voltage V_1, respectively.
[0101]
The power supply circuit 51 supplies each voltage to the signal electrode driver 53 with each wiring 66, 62, 63, and 67 connected to the outgoing ends 70, 72, 73, and 75 of voltage V_0, V_2, V_3, and V_5.
[0102]
Choosing a scanning electrode, the scanning electrode driver 52 drives the liquid crystal cell 1 so that all the scanning electrodes may be scanned. The signal electrode driver 53 sets up the potential of each signal electrode during one selection period of a scanning electrode according to the indicative data of the pixel of a selection row. At the time of a straight polarity drive, the signal electrode driver 53 sets the potential of the signal electrode in which the pixel which

should be made to turn on among the pixels of a selection row exists as V_0, and sets the potential of the signal electrode in which the pixel which should be made to turn on does not exist as V_2. At the time of a negative polarity drive, the signal electrode driver 53 sets the potential of the signal electrode in which the pixel which should be made to turn on among the pixels of a selection row exists as V_5, and sets the potential of the signal electrode in which the pixel which should be made to turn on does not exist as V_3.
[0103]
Drawing 9 is an explanatory view showing the example of composition of the scanning electrode driver 52. The scanning electrode driver 52 has the following.
First wiring 85 in which it is connected to the V_5 wiring 65, and voltage V_5 is supplied.
Second wiring 86 in which it is connected to the V_4 wiring 64, and voltage V_4 is supplied.
Third wiring 87 in which it is connected to the V_1 wiring 61, and voltage V_1 is supplied.
Fourth wiring 88 in which it is connected to the V_0 wiring 60, and voltage V_0 is supplied.
Each scanning electrode is connected to either of the fourth wiring 88 from the first wiring 85. If the wiring to which a scanning electrode is connected is changed, the potential of the scanning electrode will also be changed. Each scanning electrode, the switch 81 corresponding to the couple 1 - 83 grades perform the change of connection. The switches 81-83 are connected to the scanning electrode of the first to third line, respectively. In drawing 9, although the switch corresponding to the third line is shown from the first line, the scanning electrode driver 52 has a switch corresponding to each line.
[0104]
In a straight polarity drive, the scanning electrode driver 52 connects the scanning electrode of a non selection line to the third wiring 87 with the switch corresponding to a non selection line, and sets the potential of a non selection line as V_1. The scanning electrode of a selection row is connected to the first wiring 85 with the switch corresponding to a selection row. On the other hand, in a negative polarity drive, the scanning electrode driver 52 connects the scanning electrode of a non selection line to the second wiring 86 with the switch corresponding to a non selection line, and sets the potential of a non selection line as V_4. The scanning electrode of a selection row is connected to the fourth wiring 88 with the switch corresponding to a selection row. The scanning electrode driver 52 judges a selection row like a first embodiment based on the counter in which the input frequency of CL is shown. Based on FR, it is judged whether it should consider as a straight polarity drive, or it should consider as a negative polarity drive.
[0105]
Drawing 10 is an explanatory view showing the example of the driving waveform according to the signal with the timing to which the controller 22 outputs a signal at the time of a drive. Here, when the controller 22 directs a straight polarity drive, FR is made high-level, and when directing a negative polarity drive, the case where FR is made into a low level is explained to an example. The case where the controller 22 changes the level of FR for every frame is explained to an example. The scanning electrode driver 2 will change the scanning electrode chosen according to CL inputted following FLM one by one, if FLM is inputted. Period T_r after CL is inputted until the following CL is inputted is a selection period of one scanning electrode.
[0106]
It is assumed that the scanning electrode driver 52 had chosen the first line in the straight polarity drive. If CL is inputted at this time, the scanning electrode driver 52 will choose the scanning electrode of the second line. It is judged that FR at the time of CL input performs a straight polarity drive succeedingly. Therefore, the scanning electrode driver 52 connects the scanning

electrode of the second line to the first wiring 85 with the switch 82, and connects the scanning electrode of a non selection line to the third wiring 87 with each of other switch until CL is inputted next. At this time, the scanning electrode of a non selection line is connected to the outgoing end 71 of voltage V_1 via the third wiring 87 and the V_1 wiring 61, and the potential of the scanning electrode of a non selection line is set as V_1.

[0107]

The signal electrode driver 3 sets the potential of each signal electrode as V_0 or V_2 during this selection period according to the indicative data of the second line. Here, the number of the signal electrode of potential V_0 and the number of the signal electrode of potential V_2 shall be equal, and the average potential of each signal electrode at the time of a straight polarity drive shall become fixed.

[0108]

The controller 22 makes SHARE high-level between prescribed period T_s, after outputting CL. Then, the switch 78 for V_5 of the power supply circuit 51 connects the V_5 wiring 65 and the capacitor 77 for SHARE. Therefore, the scanning electrode of the second line is connected to the capacitor 77 for SHARE via the first wiring 85 and the V_5 wiring 65. As a result, the scanning electrode of the second line becomes potential [lateral electrode / of the capacitor 77 for SHARE / switch] $(V_5+V_1+V_4+V_0)$ (/4). Since electric capacity C_0 of the capacitor 77 for SHARE is large enough compared with C_r, even if it supplies an electric charge to a scanning electrode, the potential of the switch lateral electrode of the capacitor 77 for SHARE hardly changes.

[0109]

The length of prescribed period T_s is set or more [of the damping time constant (product of the resistance R and C_r of each scanning electrode) of at least one scanning electrode] to 1/2. Thus, by defining T_s, time for an electric charge to move between the capacitor 77 for SHARE and scanning electrodes is securable.

[0110]

Also in the switch 79 for V_0, SHARE connects the V_0 wiring 60 and the capacitor 77 for SHARE between high level. However, the scanning electrode driver 52 does not connect a scanning electrode to the fourth wiring 88 at the time of a straight polarity drive. Therefore, at the time of a straight polarity drive, an electric charge is not supplied to a scanning electrode via the V_0 wiring 60 and the fourth wiring 88.

[0111]

The controller 22 will make SHARE a low level, if prescribed period T_s passes since the start of a selection period. Then, the switch 78 for V_5 of the power supply circuit 51 connects the V_5 wiring 65 and the outgoing end 75 of voltage V_5. Therefore, the scanning electrode of the second line is connected to the outgoing end 75 of voltage V_5 via the first wiring 85 and the V_5 wiring 65, and the potential of the scanning electrode of the second line becomes V_5.

[0112]

The controller 22 makes SHARE high-level again between prescribed period T_s of the last in a selection period. Then, the switch 78 for V_5 of the power supply circuit 51 connects the V_5 wiring 65 and the capacitor 77 for SHARE. At this time, an electric charge moves to the capacitor for SHARE from the scanning electrode of the second line, and the scanning electrode of the second line serves as potential [lateral electrode / of the capacitor 77 for SHARE / switch] $(V_5+V_1+V_4+V_0)$ (/4). Since electric capacity C_0 of the capacitor 77 for SHARE is large enough compared with C_r, even if an electric charge moves from a scanning electrode, the potential of the switch lateral electrode of the capacitor 77 for SHARE hardly changes.

[0113]
The controller 22 outputs CL at the time of the start of the next selection period. If this CL is inputted, the scanning electrode driver 2 will connect the scanning electrode of the third line to the first wiring 85 with the third-line switch, and will connect other scanning electrodes to the fourth wiring 87 with each of other switch. As a result, the scanning electrode of the second line is connected to the outgoing end 71 of voltage V_1 via the fourth wiring 87 and the V_1 wiring 61. And the potential of the scanning electrode of the second line changes from $(V_5+V_0+V_4+V_1) / 4$ to V_1.
[0114]
As well as the time of the second-line selection when choosing other lines, the controller 22 and the power supply circuit 23 operate. As a result, the process in which move an electric charge to the scanning electrode of a selection row from the capacitor 77 for SHARE by prescribed period T_s of the beginning of each selection period, and an electric charge is moved to the capacitor 77 for SHARE from the scanning electrode of a selection row by prescribed period T_s of the last of each selection period is repeated. The number of times which connects the scanning electrode selected between prescribed period T_s of the beginning of each selection period to a capacitor (capacitor 77 for SHARE) is 1 time. The number of times which connects the scanning electrode selected between prescribed period T_s of the last of each selection period to a capacitor is also 1 time.
[0115]
According to such a drive method, the newly selected scanning electrode is first connected to the capacitor 77 for SHARE, and the potential of the scanning electrode of a selection row changes from V_1 to $(V_5+V_1+V_4+V_0) / 4$. At this time, an electric charge is not supplied from the outgoing end 75 of voltage V_5. Then, if the scanning electrode of a selection row is connected to the outgoing end 75 of voltage V_5, The power supply circuit 51 supplies the electric charge of C_r- (3 and V_5-V_1-V_4-V_0) / 4 from the outgoing end 75 of voltage V_5, and the potential of the scanning electrode of a selection row becomes V_5. Thus, since potential of a selection row is not raised from V_0 to V_5 and what is necessary is just to make it go up from $(V_5+V_1+V_4+V_0) / 4$ to V_5, the electric charge which should be supplied from the outgoing end 75 of voltage V_5 decreases.
[0116]
A scanning electrode of a selection row is connected to the capacitor 77 for SHARE at the last of a selection period, and potential of a scanning electrode of a selection row changes from V_5 to $(V_5+V_1+V_4+V_0) / 4$. At this time, an electric charge is not emitted to an outgoing end of voltage V_1. It is connected to the outgoing end 71 of voltage V_1 at the time of a start of the next selection period, and this scanning electrode emits an electric charge of C_r- (V_5-3 and $V_1+V_4+V_0$) / 4. And potential changes to V_1. Thus, the outgoing end 71 of voltage V_1 does not drop potential of a scanning electrode to V_0 from V_5, and what is necessary is just to drop it from $(V_5+V_1+V_4+V_0) / 4$ to V_1. Therefore, an electric charge emitted to the outgoing end 71 of voltage V_1 decreases.
[0117]
Here, the time of a straight polarity drive was explained to an example. Even if it is a case of a negative polarity drive, the power supply circuit 51 operates like the time of a straight polarity drive. Therefore, a scanning electrode of a selection row is connected to the capacitor 77 for SHARE in prescribed period T_s of the beginning of a selection period. At this time, an electric charge moves to the capacitor 77 for SHARE from a selected scanning electrode, and potential of a selected scanning electrode changes from V_4 to $(V_5+V_1+V_4+V_0) / 4$. If SHARE is set to a low level, a scanning electrode of a selection row will be connected to the outgoing end 70 of voltage

V_0. And the scanning electrode emits an electric charge and potential of a scanning electrode of a selection row becomes V_0. A scanning electrode of a selection row is again connected to the capacitor 77 for SHARE at prescribed period T_s of the last of a selection period, and potential of a scanning electrode of a selection row changes from V_0 to $(V_5+V_1+V_4+V_0) / 4$. If a selection period changes, a scanning electrode selected till then will be connected to the outgoing end 74 of voltage V_4. And an electric charge is supplied to the scanning electrode, and potential of the scanning electrode becomes V_4.
[0118]
Also in the timing which changes a straight polarity drive and a negative polarity drive, the electric charge of the capacitor 77 for SHARE can be used. Here, the timing changed from a negative polarity drive to a straight polarity drive is explained to an example. In the selection period just before changing to a straight polarity drive, the potential of each signal electrode is set as V_3 or V_5. The average potential of each signal electrode at this time assumes that it is V_4. The potential of the scanning electrode of the line (the first line) chosen as the next is set as V_4. Therefore, it can be considered that the potential difference between the scanning electrode of the first line and each signal electrode is 0V. Since it becomes a straight polarity drive in the next selection period, the signal electrode driver 53 sets the potential of each signal electrode as V_2 or V_0. The scanning electrode of the first line chosen in the selection period is connected to the capacitor 77 for SHARE. As a result, the potential of the scanning electrode of the first line is set to /4 [higher $(V_5+V_1+V_4+V_0)$ than the potential (average potential of each signal electrode is made into V_1.) of each signal electrode]. Then, the power supply circuit 51 supplies an electric charge to the scanning electrode of the first line from the outgoing end 75 of voltage V_5, and supplies an electric charge to each signal electrode via the wiring 62 and 66 connected to the outgoing ends 72 and 70 of voltage V_2 and V_0. Then, the potential of the scanning electrode of the first line rises to V_5, and the potential of each signal electrode is maintained with V_2 or V_0 (average potential is V_1). The potential difference between the scanning electrode of the first line and each signal electrode does not supply an electric charge from the state which is 0V, but the outgoing end 75 of voltage V_5 should just supply an electric charge from the state as for which the potential of the scanning electrode of the first line already became higher than the potential of a signal electrode. Therefore, the electric charge which the outgoing end 75 of voltage V_5 should supply decreases.
[0119]
According to a second embodiment, not only in when changing a straight polarity drive and a negative polarity drive, but each selection period, an electric charge of the capacitor 77 for SHARE can be used. Therefore, power consumption can be reduced in each selection period. Since potential of a non selection line is maintained at V_1 or V_4, display quality does not fall.
[0120]
Next, a converged value of potential of a switch lateral electrode of the capacitor 77 for SHARE is explained. It is assumed that it drove only by straight polarity drive, without changing to a negative polarity drive. In this case, a converged value of potential (potential of a switch lateral electrode) of the capacitor 77 for SHARE is set to $(V_5+V_1) / 2$. This converged value can be drawn by calculation which calculates a converged value of a capacitor for V_r in a first embodiment, and same calculation. When it assumes that it drove only by negative polarity drive, a converged value can be drawn with $(V_4+V_0) / 2$ by same calculation.
[0121]
If electric capacity C_0 of the capacitor 77 for SHARE is small, when changing a straight polarity

drive and a negative polarity drive with a constant period, potential of the capacitor 77 for SHARE will be stabilized. However, in this invention, C_0 is enlarged enough compared with C_r. In this case, potential of a switch lateral electrode of the capacitor 77 for SHARE is converged on average value of $(V_5+V_1) / 2$, and $(V_4+V_0) / 2$. Therefore, a converged value of potential of the capacitor 77 for SHARE in a case of changing a straight polarity drive and a negative polarity drive with a constant period is set to $(V_5+V_1+V_4+V_0) / 4$.

[0122]

Drawing 8 showed the case where the power supply circuit 51 was provided with the one capacitor 77 for SHARE. As shown in drawing 11, it may have the two capacitors 178,179 for SHARE, and each capacitor may be made equivalent to the switch 78 for V_5, and the switch 79 for V_0, respectively. The capacitor 178 shown in drawing 11 is a capacitor corresponding to potential at the time of the first selection, and the capacitor 179 is a capacitor corresponding to potential at the time of the second selection.

[0123]

In explanation of a second embodiment, it asks for the charge quantity which the outgoing end 75 of voltage V_5 supplies, the potential of a scanning electrode, etc. by calculation.

[0124]

[Embodiment 3] Next, a third embodiment is described. According to a third embodiment, APT or MLA is adopted. First, the case where APT is adopted is explained. When adopting APT, the drive of a liquid crystal display is expressed by the same block diagram as drawing 1. The composition of a scanning electrode driver is similarly expressed as drawing 3. However, in a third embodiment, the composition of a power supply circuit differs from a first embodiment. In a third embodiment, the controller 22 outputs SHARE as a signal of two or more bits (here, it may be 2 bits.). Hereafter, a 2-bit SHARE signal is described as "SHARE (1:0)." The controller 22 outputs either 00b, 01b or 10b as a SHARE (1:0). This "b" is a mark which shows that it is a binary numeral.

[0125]

Drawing 12 is an explanatory view showing an example of a power supply circuit in a third embodiment. The same mark as drawing 2 shows the same formation part as the power supply circuit 23 shown in drawing 2, and explanation is omitted. The power supply circuit 91 in a third embodiment is provided with the following.

The outgoing end 27 of voltage V_r is made to correspond, and it is the first capacitor 92 for V_r. The second capacitor 93 for V_r.

The outgoing end 29 of voltage-V_r is made to correspond and it has the first capacitor 94 for $-V_r$, and the second capacitor 95 for $-V_r$. The capacitors 92 and 93 for V_r are capacitors corresponding to potential at the time of the first selection. -The capacitors 94 and 95 for V_r are capacitors corresponding to potential at the time of the second selection.

[0126]

The switch 30 for V_r and the switch 31 for $-V_r$ change the connection destination of the V_r wiring 24 and the $-V_r$ wiring 26 according to SHARE (1:0), respectively. Hereafter, when SHARE (1:0) is 00b, the switch 30 for V_r and the switch 31 for $-V_r$ shall change the connection destination of wiring to the first capacitor 92 for V_r, and the first capacitor 94 for $-V_r$, respectively. When SHARE (1:0) is 01b, the connection destination of wiring shall be changed to the second capacitor 93 for V_r, and the second capacitor 95 for $-V_r$, respectively. When SHARE (1:0) is 10b, the connection destination of wiring shall be changed to the outgoing end 27 of voltage V_r, and the outgoing end 29 of voltage-V_r, respectively.

[0127]
Electric capacity C_0 of the first capacitor 92 for V_r, the second capacitor 93 for V_r, the first capacitor 94 for $-V_r$, and the second capacitor 95 for $-V_r$, It is preferred that they are 10 or more times of electric capacity C_r of the capacitor which one scanning electrode and each signal electrode form. They may be 100 or more times still more preferably. When C_0 is larger enough than C_r, if time passes, the potential of the switch lateral electrode of each capacitors 92-95 will be converged on an almost fixed value. So that it may mention later the converged value of the potential of the switch lateral electrode of the first capacitor 92 for V_r, the second capacitor 93 for V_r, the first capacitor 94 for $-V_r$, and the second capacitor 95 for $-V_r$, It is $V_r/3$, (2 and V_r) / 3, $-V_r/3$, and - (2 and V_r)/3, respectively.
[0128]
Drawing 13 is the timing to which the controller 22 outputs CL and SHARE (1:0), and an explanatory view showing the example of the driving waveform according to the signal. Since the controller 22 of the timing which outputs FLM and FR was the same as that of drawing 4, it omitted. By drawing 13, FR is high-level and the case where a straight polarity drive is performed is explained to an example.
[0129]
The controller 22 sets SHARE (1:0) to 00b between prescribed period T_s from the start time (at the time of CL output) of each selection period, and outputs SHARE (1:0) as 01b between subsequent prescribed period T_s. Then, the controller 22 outputs SHARE (1:0) as 10b. If predetermined period T_1 passes after setting SHARE (1:0) to 10b, the controller 22 will output SHARE (1:0) as 01b between predetermined period T_s. Then, if prescribed period T_s passes after setting SHARE (1:0) to 01b, the controller 22 will output SHARE (1:0) as 00b. If prescribed period T_s passes after setting SHARE (1:0) to 00b, CL is outputted and the start of a new selection period is directed. As shown in drawing 13, the controller 22 continues outputting 00b from prescribed period T_s before CL output to prescribed period T_s after CL output. Predetermined period T_1 is the period which deducted the 4 times as many period as prescribed period T_s from selection period T_r.
[0130]
The controller 22 connects a scanning electrode of a selection row to two or more capacitors (for example, capacitors 92 and 93 for V_r) in order by changing SHARE (1:0) in this way between fixed time (period of two times of prescribed period T_s) of the beginning of a selection period. A scanning electrode of a selection row is connected to two or more capacitors in reverse turn between fixed time (period of two times of prescribed period T_s) of the last of a selection period.
[0131]
The scanning electrode driver 2 will choose a scanning electrode of the first line, if CL is first inputted following FLM. Based on FR, it is judged whether it should consider as a straight polarity drive, or it should consider as a negative polarity drive. In this example, the scanning electrode driver 2 judges that it is a straight polarity drive, and connects a scanning electrode of the first line to the first wiring 14 with the first-line switch. A scanning electrode of a non selection line is connected to the second wiring 15 with the switch corresponding to a non selection line. At this time, a scanning electrode of a non selection line is connected to the outgoing end 28 of voltage V_M via the second wiring 15 and the V_M wiring 25. And potential of a scanning electrode of a non selection line is set as V_M.
[0132]
The signal electrode driver 3 sets potential of each signal electrode as V_c or $-V_c$ during a

selection period according to an indicative data of the first line. Here, a number of a signal electrode of potential V_c and a number of a signal electrode of potential-V_c shall be equal, and average potential of each signal electrode shall become fixed.
[0133]
The controller 22 sets SHARE (1:0) to 00b between prescribed period T_s, after outputting CL. Then, the switch 30 for V_r of the power supply circuit 91 connects the V_r wiring 24 and the first capacitor 92 for V_r. Therefore, the scanning electrode of the first line is connected to the first capacitor 92 for V_r via the first wiring 14 and the V_r wiring 24. as a result, the scanning electrode of the first line -- the switch lateral electrode of the first capacitor 92 for V_r -- being equipotential ($V_r/3$) -- it becomes. Since C_0 is large enough compared with C_r, even if it supplies an electric charge to a scanning electrode, the potential of the switch lateral electrode of the first capacitor 92 for V_r hardly changes.
[0134]
The length of prescribed period T_s is set like a first embodiment or more [of the damping time constant (product of the resistance R and C_r of each scanning electrode) of at least one scanning electrode] to 1/2.
[0135]
The controller 22 will set SHARE (1:0) to 01b, if prescribed period T_s passes since the start of a selection period. Then, the switch 30 for V_r of the power supply circuit 91 connects the V_r wiring 24 and the second capacitor 93 for V_r. As a result, the scanning electrode of the first line serves as potential [lateral electrode / of the second capacitor 93 for V_r / switch] (2 and V_r) (/3). Since C_0 is large enough compared with C_r, even if it supplies an electric charge to a scanning electrode, the potential of the switch lateral electrode of the second capacitor 93 for V_r hardly changes.
[0136]
While SHARE (1:0) of the switch 31 for -V_r is 00b, -Connect the V_r wiring 26 and the first capacitor 94 for -V_r, and while SHARE (1:0) is 01b, connect the -V_r wiring 26 and the second capacitor 95 for -V_r. However, the scanning electrode driver 2 does not connect each scanning electrode to the third wiring 16 at the time of a straight polarity drive. Therefore, an electric charge is not delivered [the first capacitor 94 for -V_r and the second capacitor 95 for -V_r] at the time of a straight polarity drive and received between scanning electrodes via -V_r wiring.
[0137]
The controller 22 will set SHARE (1:0) to 10b, if prescribed period T_s passes after changing SHARE (1:0) to 01b. Then, the switch 30 for V_r connects the V_r wiring 24 and the outgoing end 27 of voltage V_r. Therefore, the scanning electrode of the first line is connected to the outgoing end 27 of voltage V_r via the first wiring 14 and the V_r wiring 24, and the potential of the scanning electrode of the first line becomes V_r.
[0138]
The controller 22 will change SHARE (1:0) to 01b, if predetermined period T_1 passes after changing SHARE (1:0) to 10b. If SHARE (1:0) is set to 01b, the switch 30 for V_r will connect the V_r wiring 24 and the second capacitor 93 for V_r again. At this time, an electric charge moves to the second capacitor 93 for V_r from the scanning electrode of the first line, and the potential of the scanning electrode of the first line is set to (2 and V_r) / 3. Even if an electric charge moves from a scanning electrode, the potential of the switch lateral electrode of the second capacitor 93 for V_r hardly changes.
[0139]

The controller 22 will change SHARE (1:0) to 00b, if prescribed period T_s passes after changing SHARE (1:0) to 01b. If SHARE (1:0) is set to 00b, the switch 30 for V_r will connect the V_r wiring 24 and the first capacitor 92 for V_r. At this time, an electric charge moves to the first capacitor 92 for V_r from the scanning electrode of the first line, and the potential of the scanning electrode of the first line is set to $V_r/3$. Even if an electric charge moves from a scanning electrode, the potential of the switch lateral electrode of the first capacitor 92 for V_r hardly changes.

[0140]

The controller 22 will output CL, if prescribed period T_s passes after changing SHARE (1:0) to 00b. The scanning electrode driver 2 will connect a scanning electrode of the second line to the first wiring 14 with the second-line switch, if this CL is inputted. Other scanning electrodes are connected to the second wiring 15 with each of other switch. As a result, a scanning electrode of the first line is connected to the outgoing end 28 of voltage V_M via the second wiring 15 and the V_M wiring 25. And potential of a scanning electrode of the first line changes from $V_r/3$ to V_M.

[0141]

Also when choosing the second line or subsequent ones, the controller 22 and the power supply circuit 91 repeat the same operation as the time of the first-line selection. That is, an electric charge is supplied to the beginning of each selection period to a scanning electrode of a selection row in an order from the first capacitor 92 for V_r, and the second capacitor 93 for V_r. And in the last of each selection period, an electric charge is moved to the second capacitor 93 for V_r, and the first capacitor 92 for V_r in order from a scanning electrode of a selection row.

[0142]

According to such a drive method, a newly selected scanning electrode is first connected to the first capacitor 92 for V_r, and potential of a selection row changes from V_M to $V_r/3$. Then, it is connected to the second capacitor 92 for V_r, and potential of a selection row changes from $V_r/3$ to (2 and V_r) / 3. The outgoing end 27 of voltage V_r does not supply an electric charge until potential of a selection row is set to (2 and V_r) / 3 from V_M. Then, if a scanning electrode of a selection row is connected to the outgoing end 27 of voltage V_r, the power supply circuit 91 will supply an electric charge of C_r and $V_r/3$ from the outgoing end 27 of voltage V_r, and potential of a scanning electrode of a selection row will become V_r. Thus, what is necessary is to supply an electric charge of C_r and $V_r/3$ to a selection row of potential (2 and V_r)/3, and just to make potential into V_r, When potential of a selection row is V_M, it is not necessary to supply an electric charge of C_r and V_r and to make potential of a selection row into V_r. Therefore, an electric charge which should be supplied from the outgoing end 27 of voltage V_r decreases.

[0143]

In the last of a selection period, the scanning electrode of a selection row is first connected to the second capacitor 93 for V_r, and the potential of the scanning electrode of a selection row changes from V_r to (2 and V_r) / 3. Then, it is connected to the first capacitor 92 for V_r, and the potential of the scanning electrode of a selection row changes from (2 and V_r) / 3 to $V_r/3$. An electric charge is not emitted to the outgoing end 28 of voltage V_M from a selection row until the potential of a selection row is set to $V_r/3$ from V_r. It is connected to the outgoing end 28 of voltage V_M at the time of the start of the next selection period, and this scanning electrode emits the electric charge of C_r and $V_r/3$. And the potential of the scanning electrode changes to V_M. Thus, what is necessary is to emit the electric charge of C_r and $V_r/3$ from the selection row of potential $V_r/3$, and just to make potential into V_M, and when the potential of a selection row is V_r, it is not necessary to emit the electric charge of C_r and V_r and to make potential of a selection row into

V_M. Therefore, the electric charge emitted to the outgoing end 28 of voltage V_M decreases.
[0144]
Here, the time of a straight polarity drive was explained to the example. The operation at the time of a negative polarity drive is the same as that of the time of a straight polarity drive except the point which an electric charge moves between the first capacitor 94 for $-V_r$ and the second capacitor 95 for $-V_r$, and a scanning electrode. That is, by prescribed period T_s of the beginning of a selection period, the first capacitor 94 for $-V_r$ supplies an electric charge to the scanning electrode of a selection row, and sets potential of a selection row to $-V_r/3$. In continuing prescribed period T_s, the second capacitor 95 for $-V_r$ supplies an electric charge to the scanning electrode of a selection row, and sets potential of a selection row to - (2 and V_r)/3. Then, an electric charge is supplied to the scanning electrode of a selection row from the outgoing end 29 of $-V_r$ voltage, and potential of a selection row is made into $-V_r$. In subsequent prescribed period T_s, an electric charge is moved to the second capacitor 95 for $-V_r$ from the scanning electrode of a selection row, and potential of a selection row is set to - (2 and V_r)/3. By continuing prescribed period T_s, an electric charge is moved to the first capacitor 94 for $-V_r$ from the scanning electrode of a selection row, and potential of a selection row is set to $-V_r/3$. If a selection period changes, an electric charge is moved to the outgoing end 28 of voltage V_M from the scanning electrode selected till then, and it is potential. - It is made to change from $V_r/3$ to V_M.
[0145]
According to the drive method of a third embodiment, an electric charge is gradually moved to two or more capacitors from the scanning electrode chosen as the last of selection period T_r. And an electric charge is gradually supplied to the scanning electrode chosen as the next from two or more capacitors. Therefore, the charge quantity emitted to the outgoing end 28 of voltage V_M from the scanning electrode selected till then and the charge quantity supplied to the scanning electrode chosen from the outgoing end 27 of voltage V_r as the next can be decreased at the time of a selection row change. Not only in when changing from a straight polarity drive to a negative polarity drive, but each selection period, there are little charge quantity which should be supplied, and charge quantity emitted, and it ends. Therefore, the power consumption at the time of driving a liquid crystal display can be reduced. Since the potential of a non selection line is maintained at V_M, the potential of a non selection line changes and display quality does not fall.
[0146]
Next, the converged value of the potential of the switch lateral electrode of the first capacitor 92 for V_r, the second capacitor 93 for V_r, the first capacitor 94 for $-V_r$, and the second capacitor 95 for $-V_r$ is explained. Here, the first capacitor 92 for V_r and the second capacitor 93 for V_r which are used at the time of a straight polarity drive are explained to an example. Suppose that the potential of the switch lateral electrode of the first capacitor 92 for V_r is V_a at a certain time during the period when SHARE (1:0) is 10b. Suppose that the potential of the switch lateral electrode of the second capacitor 93 for V_r is V_b.
[0147]
If its attention is paid to the first capacitor 92 for V_r, the first capacitor 92 for V_r will supply an electric charge to the scanning electrode of potential V_M, and will repeat the process in which an electric charge is received from the scanning electrode which is potential V_b. Therefore, potential V_a of the switch lateral electrode of the first capacitor 92 for V_r is stabilized in $V_b/2$. This converged value $V_b/2$ can be drawn by the calculation which calculates the converged value of the capacitor for V_r in a first embodiment, and same calculation.
[0148]

Similarly, if its attention is paid to the second capacitor 93 for V_r, the second capacitor 93 for V_r will supply an electric charge to the scanning electrode of potential V_a, and will repeat the process in which an electric charge is received from the scanning electrode which is potential V_r. Therefore, switch lateral electrode V_b of the second capacitor 93 for V_r is stabilized in $(V_a+V_r) / 2$.

[0149]

Thus, V_b is the intermediate potential of V_a and V_r and V_a is the intermediate potential of V_b and V_M (=0V). Therefore, the relation of the following formulas 8 is materialized.

[0150]

$V_r-V_b=V_b-V_a=V_b / 2$ (formula 8)

[0151]

It will be set to $V_a=V_r/3$, and $V_b=2$ and $V_r/3$ if the formula 8 is solved about V_a and V_b.

[0152]

The potential of the switch lateral electrode of the first capacitor 94 for $-V_r$ and the second capacitor 95 for $-V_r$ can be similarly drawn with $-V_r/3$, and - (2 and V_r)/3, respectively.

[0153]

Next, the case where MLA is adopted is explained. When adopting MLA, the drive of a liquid crystal display is expressed by the same block diagram as drawing 5. However, as a power supply circuit, the power supply circuit 91 shown in drawing 12 is used.

[0154]

The scanning electrode driver 42 will determine potential of each scanning electrode of a subgroup to choose based on FR and ROW (1:0), if CL is inputted. Here, a scanning electrode of the first line and the third line in a subgroup is made into V_r, and a case where a scanning electrode of the second line and the fourth line is made into $-V_r$ is explained to an example. The scanning electrode driver 42 connects to the second wiring 15 a scanning electrode of a subgroup which is not chosen, and makes potential of the scanning electrode V_M. The electrode driver 42 connects a scanning electrode of the first line and the third line to the first wiring 14 with the switch corresponding to the first line of a subgroup to choose, and the third line. A scanning electrode of the second line and the fourth line is connected to the third wiring 16 with the switch corresponding to the second line of the subgroup, and the fourth line.

[0155]

The controller 41 sets SHARE (1:0) to 00b between prescribed period T_s, after outputting CL. Then, the switch 30 for V_r of the power supply circuit 91 connects the V_r wiring 24 and the first capacitor 92 for V_r. -The switch 31 for V_r connects the $-V_r$ wiring 26 and the first capacitor 94 for $-V_r$. As a result, selected potential of a scanning electrode of the first line and the third line of a subgroup changes from V_M to $V_r/3$. Potential of a scanning electrode of the second line and the fourth line changes from V_M to $-V_r/3$.

[0156]

The controller 41 will set SHARE (1:0) to 01b, if prescribed period T_s passes since the start of a selection period. Then, the switch 30 for V_r connects the V_r wiring 24 and the second capacitor 93 for V_r. -The switch 31 for V_r connects the $-V_r$ wiring 26 and the second capacitor 95 for $-V_r$. As a result, the selected potential of the scanning electrode of the first line and the third line of a subgroup changes from $V_r/3$ to (2 and V_r) / 3. Potential of the scanning electrode of the second line and the fourth line - It changes to - (2 and V_r)/3 from $V_r/3$.

[0157]

The controller 41 will set SHARE (1:0) to 10b, if prescribed period T_s passes after changing

SHARE (1:0) to 01b. Then, the switch 30 for V_r connects the V_r wiring 24 and the outgoing end 27 of voltage V_r. -The switch 31 for V $_r$ connects the -V_r wiring 26 and the outgoing end 29 of voltage-V_r. As a result, the selected potential of the scanning electrode of the first line and the third line of a subgroup changes from (2 and V_r) / 3 to V_r. Potential of the scanning electrode of the second line and the fourth line - (2 and V_r) It changes from /3 to -V_r.

[0158]

The controller 41 will change SHARE (1:0) to 01b, if predetermined period T_l passes after changing SHARE (1:0) to 10b. Then, the switch 30 for V_r connects the V_r wiring 24 and the second capacitor 93 for V_r. -The switch 31 for V $_r$ connects the -V_r wiring 26 and the second capacitor 95 for -V_r. As a result, the selected potential of the scanning electrode of the first line and the third line of a subgroup changes from V_r to (2 and V_r) / 3. The potential of the scanning electrode of the second line and the fourth line changes from -V_r to - (2 and V_r)/3.

[0159]

The controller 41 will change SHARE (1:0) to 00b, if prescribed period T_s passes after changing SHARE (1:0) to 01b. Then, the switch 30 for V_r connects the V_r wiring 24 and the first capacitor 92 for V_r. -The switch 31 for V $_r$ connects the -V_r wiring 26 and the first capacitor 94 for -V_r. As a result, the selected potential of the scanning electrode of the first line and the third line of a subgroup changes to V_r/3 from (2 and V_r) / 3. Potential of the scanning electrode of the second line and the fourth line - (2 and V_r) It changes to -V_r/3 from /3.

[0160]

The controller 41 will output CL, if prescribed period T_s passes after changing SHARE (1:0) to 00b. The scanning electrode driver 2 will connect the scanning electrode of the subgroup selected till then to the second wiring 14, if this CL is inputted. As a result, the potential of the scanning electrode of the subgroup selected till then changes to V_M.

[0161]

Thus, the situation which receives or emits an electric charge does not change each scanning electrode of the selected subgroup to the case of APT. Therefore, even when MLA is adopted, the electric charge which should be supplied to a scanning electrode from the outgoing end 27 of voltage V_r or the outgoing end 29 of voltage-V_r can be decreased. The electric charge emitted to the outgoing end 28 of voltage V_M from a scanning electrode can also decrease. As a result, power consumption decreases. Since the potential of the subgroup which is not chosen does not turn into any potential other than V_M, display quality is also maintainable.

[0162]

In the above-mentioned explanation, it asks for the charge quantity which the outgoing end 27 of voltage V_r supplies, the potential of a scanning electrode, etc. by calculation. It checked that the electric charge was reused effectively not only the check by calculation but by actually driving a liquid crystal display. Hereafter, an embodiment is shown.

[0163]

[Embodiment 4] The same liquid crystal cell as Embodiment 1 was driven with the drive method by a third embodiment. Electric capacity C_r of the capacitor which one scanning electrode and each signal electrode form in this liquid crystal cell is 0.34nF like Embodiment 1. The damping time constant of one scanning electrode is estimated at 1.4 microseconds. Electric capacity C_0 formed the capacitor which is 1 micro F (about 3000 times of C_r) as the capacitor for V_r, and a capacitor for -V_r. APT is adopted and it was made to drive 1/176 and frame frequency for a duty ratio as 60 Hz. Prescribed period T_s which outputs 00b and 01b as a SHARE (1:0) was set to 2.4 microseconds. At this time, the current from the outgoing end of voltage V_r was 143microA.

[0164]
[Comparative example 2] The liquid crystal display was driven like Embodiment 4 except the point which always set SHARE (1:0) to 10b. At this time, the current from the outgoing end of voltage V_r is 323microA, and increased from the case of Embodiment 4.
[0165]
[Embodiment 4] Next, a fourth embodiment is described. According to a fourth embodiment, IAPT is adopted. The drive of the liquid crystal display in a fourth embodiment is expressed by the same block diagram (drawing 7) as a second embodiment. The composition of a scanning electrode driver is similarly expressed as drawing 9. However, in a fourth embodiment, the composition of a power supply circuit differs from a second embodiment. In a fourth embodiment, the controller 22 outputs either 00b, 01b or 10b as a SHARE (1:0) like a third embodiment. However, an order which changes SHARE (1:0) is changed in the time of a straight polarity drive and a negative polarity drive.
[0166]
Drawing 14 is an explanatory view showing an example of a power supply circuit in a fourth embodiment. The same mark as drawing 8 shows the same formation part as the power supply circuit 51 shown in drawing 8, and explanation is omitted. The power supply circuit 100 in a fourth embodiment is provided with two or more capacitors for SHARE. Drawing 14 explains a case where it has the first capacitor 101 for SHARE, and the second capacitor 102 for SHARE to an example.
[0167]
The switch 78 for V_5 and the switch 79 for V_0 change the connection destination of the V_5 wiring 65 and the V_0 wiring 60 according to SHARE (1:0), respectively. Hereafter, when SHARE (1:0) is 00b, the switch 78 for V_5 and the switch 79 for V_0 shall change the connection destination of wiring to the first capacitor 101 for SHARE, respectively. When SHARE (1:0) is 01b, the connection destination of wiring shall be changed to the second capacitor 102 for SHARE, respectively. When SHARE (1:0) is 10b, the connection destination of wiring shall be changed to the outgoing end 75 of voltage V_5, and the outgoing end 70 of voltage V_0, respectively.
[0168]
As for electric capacity C_0 of the first capacitor 101 for SHARE, and the second capacitor 102 for SHARE, it is preferred that they are 10 or more times of electric capacity C_r of the capacitor which one scanning electrode and each signal electrode form. They may be 100 or more times still more preferably. When C_0 is larger enough than C_r, if time passes, the potential of the switch lateral electrode of each capacitor 101,102 for SHARE will be converged on an almost fixed value. So that it may mention later the converged value of the potential of the switch lateral electrode of the first capacitor 101 for SHARE, and the second capacitor 102 for SHARE, It is /6, and $(V_5+V_1+V_4+V_0)$ / 3, respectively $(V_5+V_1+V_4+V_0)$.
[0169]
The controller 22 changes an order which is with the time of a straight polarity drive and a negative polarity drive, and changes SHARE (1:0). In the selection period which performs a straight polarity drive, the controller 22 sets SHARE (1:0) to 00b between prescribed period T_s from the start time (at the time of CL output) of each selection period, and outputs SHARE (1:0) as 01b between subsequent prescribed period T_s. Then, the controller 22 outputs SHARE (1:0) as 10b. If predetermined period T_1 passes after setting SHARE (1:0) to 10b, the controller 22 will output SHARE (1:0) as 01b between predetermined period T_s. Then, if prescribed period T_s passes after setting SHARE (1:0) to 01b, the controller 22 will output SHARE (1:0) as 00b. If

prescribed period T_s passes after setting SHARE (1:0) to 00b, CL is outputted and the start of a new selection period is directed. The controller 22 continues outputting 00b from prescribed period T_s before CL output to prescribed period T_s after CL output. Predetermined period T_1 is the period which deducted the 4 times as many period as prescribed period T_s from selection period T_r.

[0170]

On the other hand, in a selection period which performs a negative polarity drive, the controller 22 sets SHARE (1:0) to 01b between predetermined time T_s from the start time (at the time of CL output) of each selection period, and outputs SHARE (1:0) as 00b between subsequent prescribed period T_s. Then, the controller 22 outputs SHARE (1:0) as 10b. If predetermined period T_1 passes after setting SHARE (1:0) to 10b, the controller 22 will output SHARE (1:0) as 00b between predetermined period T_s. Then, if prescribed period T_s passes after setting SHARE (1:0) to 00b, the controller 22 will output SHARE (1:0) as 01b. If prescribed period T_s passes after setting SHARE (1:0) to 01b, CL is outputted and a start of a new selection period is directed. The controller 22 continues outputting 01b from prescribed period T_s before CL output to prescribed period T_s after CL output.

[0171]

The controller 22 connects a scanning electrode of a selection row to two or more capacitors (capacitor 101,102 for SHARE) in order by changing SHARE (1:0) in this way between fixed time (period of two times of prescribed period T_s) of the beginning of a selection period. A scanning electrode of a selection row is connected to two or more of the capacitors in reverse turn between fixed time (period of two times of prescribed period T_s) of the last of a selection period.

[0172]

Drawing 15 is an explanatory view showing the example of the driving waveform according to the signal with the timing to which the controller 22 outputs CL and SHARE (1:0) at the time of a straight polarity drive. Since the controller 22 of the timing which outputs FLM and FR was the same as that of drawing 10, it omitted.

[0173]

The scanning electrode driver 52 will change a selection row, if CL is inputted from the controller 22. It is judged that FR at the time of CL input performs a straight polarity drive succeedingly. And the scanning electrode of a selection row is connected to the first wiring 85 with the switch of a selection row, and the scanning electrode of a non selection line is connected to the third wiring 87 with the switch of a non selection line. At this time, the scanning electrode of a non selection line is connected to the outgoing end 71 of voltage V_1, and the potential of the scanning electrode of a non selection line is set as V_1.

[0174]

The signal electrode driver 3 sets the potential of each signal electrode as V_0 or V_2 during a selection period according to the indicative data of the first line. Here, the number of the signal electrode of potential V_0 and the number of the signal electrode of potential V_2 shall be equal, and the average potential of each signal electrode shall become fixed.

[0175]

The controller 22 sets SHARE (1:0) to 00b between prescribed period T_s, after outputting CL. Then, the switch 78 for V_5 connects the V_5 wiring 65 and the first capacitor 101 for SHARE. Therefore, the scanning electrode of a selection row is connected to the first capacitor 101 for SHARE via the first wiring 85 and the V_5 wiring 65. As a result, the scanning electrode of a

selection row serves as potential [lateral electrode / of the first capacitor 101 for SHARE / switch] $(V_5+V_1+V_4+V_0)$ (/6).
[0176]
The length of prescribed period T_s is set like a first embodiment or more [of the damping time constant (product of the resistance R and C_r of each scanning electrode) of at least one scanning electrode] to 1/2.
[0177]
The controller 22 will set SHARE (1:0) to 01b, if prescribed period T_s passes since the start of a selection period. Then, the switch 78 for V_5 connects the V_5 wiring 65 and the second capacitor 102 for SHARE. As a result, the scanning electrode of a selection row serves as potential [lateral electrode / of the second capacitor 102 for SHARE / switch] $(V_5+V_1+V_4+V_0)$ (/3).
[0178]
While SHARE (1:0) of the switch 79 for V_0 is 00b, The V_0 wiring 60 and the first capacitor 101 for SHARE are connected, and while SHARE (1:0) is 01b, the V_0 wiring 60 and the second capacitor 102 for SHARE are connected. However, the scanning electrode driver 2 does not connect a scanning electrode to the fourth wiring 88 at the time of a straight polarity drive. Therefore, an electric charge is not delivered [the first capacitor 101 for SHARE and the second capacitor 102 for SHARE] at the time of a straight polarity drive and received between scanning electrodes via the V_0 wiring 60.
[0179]
The controller 22 will set SHARE (1:0) to 10b, if prescribed period T_s passes after changing SHARE (1:0) to 01b. Then, the switch 78 for V_5 connects the V_5 wiring 65 and the outgoing end 75 of voltage V_5. Therefore, the scanning electrode of a selection row is connected to the outgoing end 75 of voltage V_5 via the first wiring 85 and the V_5 wiring 65, and the potential of the scanning electrode of a selection row becomes V_5.
[0180]
The controller 22 will change SHARE (1:0) to 01b, if predetermined period T_1 passes after changing SHARE (1:0) to 10b. If SHARE (1:0) is set to 01b, the switch 78 for V_5 will connect the V_5 wiring 65 and the second capacitor 102 for SHARE again. At this time, an electric charge moves to the second capacitor 102 for SHARE from a scanning electrode of a selection row, and potential of a scanning electrode of a selection row is set to $(V_5+V_1+V_4+V_0) / 3$.
[0181]
The controller 22 will change SHARE (1:0) to 00b, if prescribed period T_s passes after changing SHARE (1:0) to 01b. If SHARE (1:0) is set to 00b, the switch 78 for V_5 will connect the V_5 wiring 65 and the first capacitor 101 for SHARE. At this time, an electric charge moves to the first capacitor 101 for SHARE from a scanning electrode of a selection row, and potential of a scanning electrode of a selection row is set to $(V_5+V_1+V_4+V_0) / 6$.
[0182]
The controller 22 will output CL, if prescribed period T_s passes after changing SHARE (1:0) to 00b. If this CL is inputted, the scanning electrode driver 52 will connect a newly chosen scanning electrode to the first wiring 85, and will connect other scanning electrodes to the third wiring 87. As a result, a scanning electrode selected till then is connected to the outgoing end 71 of voltage V_1, and potential of that scanning electrode changes from $(V_5+V_1+V_4+V_0) / 6$ to V_1.
[0183]
Also when choosing other lines, the controller 22 and the power supply circuit 100 repeat the same operation. That is, an electric charge is supplied to the beginning of each selection period to

the scanning electrode of a selection row in an order from the first capacitor 101 for SHARE, and the second capacitor 102 for SHARE. And in the last of each selection period, an electric charge is moved to the second capacitor 102 for SHARE, and the first capacitor 101 for SHARE in order from the scanning electrode of a selection row.

[0184]

According to such a drive method, the newly selected scanning electrode is first connected to the first capacitor 101 for SHARE, and the potential of the scanning electrode of a selection row changes from V_1 to $(V_5+V_1+V_4+V_0) / 6$. Then, it is connected to the second capacitor 102 for SHARE, and the potential of the scanning electrode of a selection row changes from $(V_5+V_1+V_4+V_0) / 6$ to $(V_5+V_1+V_4+V_0) / 3$. An electric charge is not supplied from the outgoing end 75 of voltage V_5 until the potential of the scanning electrode of a selection row changes from V_1 to $(V_5+V_1+V_4+V_0) / 3$. Next, if the scanning electrode of a selection row is connected to the outgoing end 75 of voltage V_5 via V_5 wiring 65 grade, The power supply circuit 100 supplies the electric charge of C_r- (2 and V_5-V_4-V_1-V_0) / 3 from the outgoing end 75 of voltage V_5, and the potential of the scanning electrode of a selection row becomes V_5. Thus, since potential of a selection row is not raised from V_0 to V_5 and what is necessary is just to make it go up from $(V_5+V_1+V_4+V_0) / 3$ to V_5, the electric charge which should be supplied from the outgoing end 75 of voltage V_5 decreases.

[0185]

When dropping the potential of a selection row to V_1, the scanning electrode of a selection row is first connected to the second capacitor 102 for SHARE, and the potential of the scanning electrode of a selection row changes from V_5 to $(V_5+V_1+V_4+V_0) / 3$. Then, it is connected to the first capacitor 101 for SHARE, and the potential of the scanning electrode of a selection row changes from $(V_5+V_1+V_4+V_0) / 3$ to $(V_5+V_1+V_4+V_0) / 6$. An electric charge is not emitted to the outgoing end 71 of voltage V_1 from a scanning electrode until the potential of the scanning electrode of a selection row changes from V_5 to $(V_5+V_1+V_4+V_0) / 6$. This scanning electrode is connected to the outgoing end 71 of voltage V_1 via V_1 wiring 61 grade at the time of the start of the next selection period. Then, this scanning electrode emits the electric charge of C_r- (V_5+V_4-5 and V_1+V_0) / 6 to the outgoing end 71 of voltage V_1, and the potential of a scanning electrode changes to V_1. Thus, the outgoing end 71 of voltage V_1 does not drop the potential of a scanning electrode to V_1 from V_5, and what is necessary is just to drop it from $(V_5+V_1+V_4+V_0) / 6$ to V_1. Therefore, the electric charge emitted to the outgoing end 71 of voltage V_1 decreases.

[0186]

Here, the time of a straight polarity drive was explained to an example. Even if it is a case of a negative polarity drive, the power supply circuit 100 operates like the time of a straight polarity drive. Drawing 16 is an explanatory view showing an example of a driving waveform according to the signal with timing to which the controller 22 outputs CL and SHARE (1:0) at the time of a negative polarity drive.

[0187]

In a negative polarity drive, the controller 22 sets SHARE (1:0) to 01b in prescribed period T_s of the beginning of a selection period. At this time, a scanning electrode of a selection row is connected to the second capacitor 102 for SHARE via V_0 wiring 60 grade. Then, an electric charge moves to the second capacitor 102 for SHARE from a scanning electrode of a selection row, and potential of a selection row changes from V_4 to $(V_5+V_1+V_4+V_0) / 3$. If SHARE (1:0) is set to 00b, a scanning electrode of a selection row will be connected to the first capacitor 101 for SHARE. Then, an electric charge moves to the first capacitor 101 for SHARE from a scanning

electrode of a selection row, and potential of a selection row changes from $(V_5+V_1+V_4+V_0) / 3$ to $(V_5+V_1+V_4+V_0) / 6$. Then, if SHARE (1:0) is set to 10b, it will be connected to an outgoing end of voltage V_0 via V_0 wiring 60 grade, and a scanning electrode of a selection row will emit an electric charge. And potential of a scanning electrode of a selection row becomes V_0.
[0188]
If SHARE (1:0) is again set to 00b, a scanning electrode of a selection row will be connected to the first capacitor 101 for SHARE, and potential of a scanning electrode of a selection row will be set to $(V_5+V_1+V_4+V_0) / 6$. Then, if SHARE (1:0) is set to 01b, a scanning electrode of a selection row will be connected to the second capacitor 102 for SHARE, and potential of a scanning electrode of a selection row will be set to $(V_5+V_1+V_4+V_0) / 3$. If the following CL is outputted and a selection row is changed, a line selected till then will be connected to the outgoing end 74 of voltage V_4 via V_4 wiring 64 grade. At this time, the outgoing end 74 of voltage V_4 supplies an electric charge to a scanning electrode selected till then, and raises potential of a scanning electrode from $(V_5+V_1+V_4+V_0) / 3$ to V_4.
[0189]
Also in timing which changes a straight polarity drive and a negative polarity drive, an electric charge of the capacitor 101,102 for SHARE can be used. For example, like a second embodiment, the outgoing end 75 of voltage V_5 is the timing changed from a negative polarity drive to a straight polarity drive, and does not need to supply an electric charge from a state where potential difference of a scanning electrode of the first line and each signal electrode is 0V. The outgoing end 75 of voltage V_5 should just supply an electric charge, after potential of a scanning electrode of the first line becomes higher than potential of each signal electrode by the first capacitor 101 for SHARE, and the second capacitor 102 for SHARE. Therefore, there are few electric charges which should be supplied and they end.
[0190]
According to the drive method of a fourth embodiment, an electric charge is gradually moved to the last of selection period T_r between a selection row and two or more capacitors. And an electric charge is gradually moved to an opposite direction between the scanning electrode chosen as the next, and two or more capacitors. Therefore, the charge quantity emitted to the outgoing end of each voltage and the charge quantity supplied from the outgoing end of each voltage can be decreased at the time of a selection row change. Therefore, the power consumption at the time of driving a liquid crystal display can be reduced. Power consumption can be reduced not only in when changing a straight polarity drive and a negative polarity drive, but each selection period. Since the potential of a non selection line is maintained at V_1 or V_4, the potential of a non selection line changes and display quality does not fall.
[0191]
Next, the converged value of the potential of the switch lateral electrode of the first capacitor 101 for SHARE and the second capacitor 102 for SHARE is explained. It is assumed that it drove only by straight polarity drive, without changing to a negative polarity drive. In this case, the potential of the switch lateral electrode of the first capacitor 101 for SHARE and the second capacitor 102 for SHARE is set to /3, and 2- $(V_5+V_1) / 3$, respectively (V_5+V_1). This converged value can be drawn by the same method as the converged value shown by a third embodiment. It is assumed that it drove only by negative polarity drive. The potential of the switch lateral electrode of the first capacitor 101 for SHARE and the second capacitor 102 for SHARE is set to /3, and 2- $(V_4+V_0) / 3$ by same calculation, respectively (V_4+V_0).
[0192]

If electric capacity C_0 of each capacitor 101,102 for SHARE is small, when changing a straight polarity drive and a negative polarity drive with a constant period, the potential of the capacitor for SHARE will be stabilized. However, in this invention, C_0 is enlarged enough compared with C_r. In this case, the potential of the switch lateral electrode of the first capacitor 101 for SHARE is converged on the average value of $(V_5+V_1) / 3$, and $(V_4+V_0) / 3$. The potential of the switch lateral electrode of the second capacitor 102 for SHARE is converged on the average value of 2- $(V_5+V_1) / 3$, and 2- $(V_4+V_0) / 3$. Therefore, the potential of the switch lateral electrode of the first capacitor 101 for SHARE, and the second capacitor 102 for SHARE, It converges on /6, and $(V_5+V_1+V_4+V_0) / 3$, respectively $(V_5+V_1+V_4+V_0)$.
[0193]
Drawing 14 showed the case where the power supply circuit 100 was provided with the two capacitors 101,102 for SHARE. The power supply circuit 100 may be separately provided with the combination of two or more capacitors for SHARE used at the time of a straight polarity drive, and the combination of two or more capacitors for SHARE used at the time of a negative polarity drive.
[0194]
In explanation of a fourth embodiment, it asks for the charge quantity which the outgoing end 75 of voltage V_5 supplies, the potential of a scanning electrode, etc. by calculation.
[0195]
By the third embodiment and fourth embodiment, when changing the potential of a selection row, the case where used two capacitors and it was made to change gradually was shown. The number of the capacitors for changing the potential of a selection row gradually may be three or more. For example, three or more capacitors may be made equivalent to the switch 30 for V_r and the switch 31 for $-V_r$ which are shown in drawing 12 in a third embodiment, respectively. For example, by a fourth embodiment, three or more capacitors for SHARE may be formed. In this case, the switch destinations of a switch increase in number according to the number of capacitors. What is necessary is just to define the number of bits of SHARE as the number of bits which can express the number of the switch destinations of a switch.
[0196]
IC may realize the scanning electrode driver and signal electrode driver which are used by each embodiment. Whether IC realizes a scanning electrode driver and a signal electrode driver does not influence how to define electric capacity C_0 or prescribed period T_s. That is, even if it uses IC, as for electric capacity C_0 of a capacitor, it is preferred to consider it as 10 or more times of C_r, and it is preferred to consider it as further 100 or more times. Prescribed period T_s uses 1/2 or more [of the damping time constant of one scanning electrode].
[0197]
[Effect of the Invention]
According to this invention, even if it is while maintaining a straight polarity drive or maintaining a negative polarity drive, the electric charge which should be supplied when changing a selection row, and the electric charge emitted can be decreased. The potential of the scanning electrode which has not been chosen does not turn into any potential other than potential at the time of non selection. Therefore, the reuse efficiency of an electric charge is raised without reducing display quality, and power consumption can be reduced more.
[Brief Description of the Drawings]
[Drawing 1]The block diagram showing the example of the drive which adopts APT.
[Drawing 2]The explanatory view showing the example of a power supply circuit.

[Drawing 3]The explanatory view showing the example of composition of a scanning electrode driver.
[Drawing 4]The explanatory view showing the example of signal output timing and a driving waveform.
[Drawing 5]The block diagram showing the example of the drive which adopts MLA.
[Drawing 6]The explanatory view showing the example of a selection row sequence.
[Drawing 7]The block diagram showing the example of the drive which adopts IAPT.
[Drawing 8]The explanatory view showing the example of a power supply circuit.
[Drawing 9]The explanatory view showing the example of composition of a scanning electrode driver.
[Drawing 10]The explanatory view showing the example of signal output timing and a driving waveform.
[Drawing 11]The explanatory view showing the example of a power supply circuit.
[Drawing 12]The explanatory view showing the example of a power supply circuit.
[Drawing 13]The explanatory view showing the example of signal output timing and a driving waveform.
[Drawing 14]The explanatory view showing the example of a power supply circuit.
[Drawing 15]The explanatory view showing the example of signal output timing and a driving waveform.
[Drawing 16]The explanatory view showing the example of signal output timing and a driving waveform.
[Drawing 17]The explanatory view showing the example of the conventional driving waveform.
[Explanations of letters or numerals]
1 Liquid crystal cell
2 Scanning electrode driver
3 Signal electrode driver
22 Controller
23 Power supply circuit
24 V_r wiring
25 V_M wiring
26 $-V_r$ wiring
30 The switch for V_r
31 The switch for $-V_r$
32 The capacitor for V_r
33 The capacitor for $-V_r$